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CONTENTS

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BRITISH JOURNAL OF TUBERCULOSIS AND DISEASES OF THE CHEST

Vol. XLVII. APRIL, 1953 No. 2.

GALEN ON THORACIC MOVEMENTS

BY PROFESSOR CHARLES SINGER

ALMOST the only general anatomical works that have survived from antiquity are those of Galen (A.D. 130-201), an Asiatic Greek who practised in Rome. There he was the medical attendant of the philosopher-emperor Marcus Aurelius (reigned 161-178) and of his son Commodus (reigned 180-192). Throughout life, but especially during certain of the years of his residence in Italy (169-175), Galen devoted himself to physiological experiments and demonstrations. He was thus able to produce a most ingenious scheme of the workings of the body and this he expounded in several of his numerous works. His system was by far the best then available and was universally accepted until the time of Harvey. Large elements of it remained long after as parts of the physiological thinking of the seventeenth, eighteenth, and nineteenth centuries. Indeed to this day we use many of the anatomical and physiological terms that come down to us from Galen's writings and some have passed into our ordinary speech.

Galen wrote in Greek of a rather peculiar kind, a sort of medical lingo affected by the Ionic Greek in which the so-called *Hippocratic Collection* has come down to us. He was a verbose and diffuse writer, whose works are devoid of literary merit. Nevertheless he often gives a very vivid picture of the practice of his day and describes anatomical structures and physiological processes carefully and accurately. The difficulty in presenting him to the modern reader is to find a concise and self-limited passage. In considering what might interest readers of the BRITISH JOURNAL OF TUBERCULOSIS I have selected a passage from his work *On Anatomical Procedures* describing the movements of the thorax. It was written about A.D. 177. I have left a few words in the original Greek, the reason for which will be apparent. Such words I have transcribed into Latin letters, writing them in capitals. I have also interpolated a few explanatory phrases in the text, enclosing them in square brackets; those in round brackets are in the original.

This text itself has not previously been rendered into any modern language. The passage will, I hope, convince the reader that experimental physiology, in the full modern sense, was being practised 1,800 years ago. For almost all his anatomy, and for much of his physiology, Galen used an ape of the genus Macaca. For the experiments on the movements of the thorax, however, he relied mostly on young pigs.

Galen had considerable private means and never lacked for material. He

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was fond of publicity and speaks constantly of his students, who seem to have been numerous. It is among the puzzles of history that he had no successors. It was many centuries before his experiments were even verified, let alone extended. The passage that I translate below is Book VIII, chapter 5, of his work *On Anatomical Procedures*.

[*Control of Thoracic Movements*]

"The nerves [*recurrent laryngeal*] that accompany those arteries that people call CAROTIDES were known to my teachers. When these nerves receive one of the injuries I mentioned not long since, the animal becomes dumb, but not to such a degree as from injury to the intercostal nerves, for it can still produce a hoarse sound like that of a man snoring in sleep. This power is lost when the intercostal muscles are paralysed; and they are quickly paralysed when either their fibres are cut, or the ribs removed, or the nerve destroyed at the root, or the spinal cord severed at the top of the thoracic vertebræ (METAPHRĒN).

In this last operation the hoarse sound is lost, since all the parts below—*i.e.*, the intercostal and abdominal muscles—are also paralysed. (These operations have been discussed in Book V, where I described how best to distinguish the eight of them.) Along with them the muscles of the anus, penis, bladder and legs are also paralysed. The diaphragm, however, though lower than the intercostals, is not paralysed because the origin of its nerves is above the thorax. Nor is there damage to the six muscles descending from the neck which dilate the thorax, and particularly its upper part, for they too have their nerves from the spinal cord (NOTIAION) in the neck.

You have seen all this publicly demonstrated when the thorax was the subject for dissection. I had to explain and demonstrate its nature during many consecutive days. When the spinal cord was severed at the beginning of the thorax, which is between the seventh and eighth vertebræ, the animal fell and lay on its side, the lower parts of the thorax being moved by the diaphragm alone, which an animal uses for shallow breathing only. When, however, it needs to fetch deeper breaths, whether by reason of exhaustion, or fever, or because of the heat, or for some bodily distress, it must invoke the intercostals to the aid of the diaphragm and, at need, the higher muscles as well.

You observed the animal, when the spinal cord was severed at the beginning of the back, falling down at once, lying on its side, remaining dumb, and its thorax devoid of movement except below, where it is moved by the action of the diaphragm. (Also you observed that the movement of the parts of the thorax is more clearly seen when all the surrounding skin has been removed.) All the intercostal muscles became completely motionless, while the lower parts of the thorax were dilating, some faint movement passing to the upper parts. So with the animal in this condition, as you know, I again cut the origins of the nerves descending into the diaphragm. Immediately the movement of the lower thorax ceased and the high muscles were forced into action, and the upper region of the thorax was clearly seen being dilated by them.

Taking a second animal and cutting the cervical nerve-roots to the diaphragm, I immobilised the lower thorax at once while the intercostals remained active.

When, however, the cord was cut at the beginning of the back, [leaving the nerves intact] the animal at once lay on its side, moving both parts of the thorax, the higher and lower [but not the middle] for, because of the need to inhale more deeply, the diaphragm alone did not suffice.

When the animal inhales with the upper muscles, the movement is plainly visible along the entire shoulder-blades as far as the top of the shoulder. When it inhales with the diaphragm alone, the hypochondria swells at each inhalation, and contracts at each exhalation, the parts at the shoulder-blades remaining motionless. When only the intercostals are called into play, the shoulder-blades are motionless, but the hypochondria contracts as the animals inhale and expands as they exhale—the reverse of what happens when the diaphragm is active.

If you choose to paralyse the muscles of the shoulder-blades you can do so in two ways, either severing them transversely or damaging their nerves. For you must know that this is true of all muscles, that whether you damage their nerves or cut their fibres, you render them motionless. So it is essential for you to know of the muscles, not only the origins of their nerves, but also the direction of their fibres. Some [fibres] run down from above, like those of the anterior and middle muscles of the thorax, some pass transversely like those of the posterior muscles [of the scapula]. In nearly all the muscles the fibres run parallel to the length, though in some they behave in the opposite way, as in the intercostal muscles.

Thus when, as I have said, you paralyse the higher muscles only, as need arises the animal invokes the activity of the intercostal muscles. I have mentioned almost all the conditions in which the animal needs to breathe deeply, but sometimes there is added, not a bodily condition, but a strong impulse, as when the animal desires to utter a cry. As a herald about to make an announcement inhales as deeply as possible to have ample breath (HYLE) for his voice, so sometimes do some animals when being dissected."

THE TUBERCULIN TEST

A COMPARISON BETWEEN THE JELLY AND MANTOUX TESTS

By Hugh W. O. Frew, J. Romanes Davidson and J. T. W. Reid

From the Health and Tuberculosis Departments, Renfrewshire and Bute, and the Orphan Homes of Scotland

With the present increasing interest in vaccination in the prevention of tuberculosis in Britain, it was decided to use this method for the protection of the children at the Orphan Homes of Scotland. The Council of Management of the Homes has always been ready to adopt new measures of this nature. This paper deals with the results of the tuberculin survey which preceded vaccination—and in particular with a comparison between the tuberculin jelly and Mantoux tests.

The Orphan Homes at present care for some 850 children between the ages of a few months and 16 years. They live in cottages containing about twenty-two children, under the care of a cottage "Father and Mother." There are several special units for babies and toddlers and, as the homes have their own church, school, hospital and playing fields, it forms a relatively closed community.

The original scheme provided for a preliminary screening of the 783 children aged over 1 year with tuberculin jelly to be followed, in the doubtful and negative reactors, by a Mantoux text using 100 international units (I.T.U.) of standardised old tuberculin. The results of the jelly test were surprising because of the abnormally high proportion of positive reactors, and also because of their irregular age distribution. It was therefore decided to re-test all children positive to jelly with 10 I.T.U. of standard old tuberculin—the negative reactors being re-tested with 100 I.T.U. as originally planned. A child was considered to be negative when it failed to react to the 100 I.T.U. old tuberculin.

Techniques and Standards

In this study the tuberculin jelly (test and control) and the dilutions of standardised old tuberculin were those prepared by the Veterinary Laboratory, Weybridge, and distributed by Messrs. Allen and Hanbury for the Government B.C.G. Vaccination Scheme. These were used well within the expiry date. The technique of testing was maintained unaltered throughout the entire study, the results being read by three observers.

The Jelly Test. The jelly was applied to the skin in the interscapular region. The skin was prepared by rubbing firmly with a pledget of cotton-wool soaked in acetone followed by stroking firmly, six times, with a 1-inch wide strip of flourpaper. The test jelly was applied in the form of a "V" on the right, and the control in the form of an inverted "V" on the left side of the spinal column. Care was taken to avoid the production of visible scratches or erythema by

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the flourpaper. A strip of adhesive plaster, 2 inches by 1 inch, was applied to both test and control areas and instructions given that they were to be removed forty-eight hours later. No flourpaper was used on the children under 5 years. The results were read at the end of seventy-two hours and were classified as positive, negative or doubtful according to the following criteria:

Positive: An area of induration alone (discounting erythema) the shape of which conformed to that of the applied jelly; or an area of little or no induration but with not less than four vesicles at the site of the applied jelly. The appearance of induration and vesiculation may occur at the same time. The control area should show no reaction.

Negative: The absence of the above skin reactions in the test area.

Doubtful: Cases which could not be definitely classified as positive or negative. Erythema from the adhesive dressings, the presence of acne and, in a few cases, a linear reaction, including vesiculation, occurring in association with minute scratches inflicted by the flourpaper, made many results difficult to read.

The Mantoux Test. The site used for the injection (0·1 ml.) was the junction of the upper third and the lower two-thirds of the volar aspect of the left forearm. The skin was cleaned with methylated ether and a fresh sterile (autoclaved) needle used in each case. Separate needles and syringes were used for the two different strengths of tuberculin. The results were read at the end of forty-eight hours (in no case later than seventy-two hours) and were classified as positive, negative or doubtful, the criteria being as follows:

Positive: An area of infiltration of 6 mm., or more, erythema being ignored.

Negative: Any reaction less than the positive.

Doubtful: Any case which could not properly be classified as positive or negative. No such case occurred in this series.

Results

The results of the jelly tests are shown in Table I below:

Table I.—Results of Jelly Tests

	Positive	*Negative*	*Doubtful*	*Total*
Number	304	355	124	783
Percentage	39	45	16	100

As will be seen from the above table, the result of the jelly test was doubtful in 16 per cent. of cases. This uncertainty was due to scratching of the skin and plaster reactions. In the entire series no significant reactions were noted in the control tests. The proportion of negative reactors seemed to us to be unduly low when compared with the results obtained in Renfrewshire during 1950-1, when routine tuberculin testing of 2,545 child contacts showed that 55·6 per cent. gave negative reactions. Further, the age distribution of the reactors was unexpected, there being as many positive in the younger as in the older children.

Because of these considerations it was decided to re-test all positive reactors with the 10 I.T.U. Mantoux test. These, if negative, were subjected, together with the negative and doubtful reactors to jelly, to a final 100 I.T.U. Mantoux test. The results of these tests are shown in Table II:

TABLE II.—RESULTS OF JELLY AND MANTOUX TESTS

Jelly	*Results*		*Number*	*Per cent. of all children tested*
	Mx. 10	*Mx.* 100		
Positive	Pos.	–	149	19·0 } 20·3
Positive	Neg.	Pos.	10	1·3 }
Positive	Neg.	Neg.	145	18·5
Negative	—	Neg.	327	41·8
Negative	—	Pos.	28	3·6
Doubtful	—	Neg.	103	13·1
Doubtful	—	Pos.	21	2·7
	Total		783	100·0

From a summary of these results, in Table III, it will be seen that a negative reaction to the tuberculin jelly was followed, in 92 per cent. of cases, by a negative reaction to the 100 I.T.U. Mantoux test. On the other hand, nearly half of those positive to the Tuberculin jelly gave a negative reaction to the 100 I.T.U. Mantoux test. Over 80 per cent. of the doubtful reactors failed to react to 100 I.T.U.

TABLE III.—COMPARISON BETWEEN THE JELLY AND MANTOUX TEST RESULTS

Jelly Tests		*Results of Mantoux Tests*	
Results	*Number*	*Positive to 10 or 100 I.T.U.*	*Negative to 100 I.T.U.*
Positive	304	159 (52·3%)	145 (47·7%)
Negative	355	28 (7·9%)	327 (92·1%)
Doubtful	124	21 (16·9%)	103 (83·1%)
Total	783	208 (26·5%)	575 (73·5%)

The above table shows that, in our experience, a negative reaction to tuberculin jelly is a fairly accurate index of the absence of sensitivity, as only 7·9 per cent. were subsequently found to be sensitive to the 100 I.T.U. Mantoux test. A positive reaction cannot be relied upon as indicating a true sensitivity when judged by its response to a subsequent 10 or 100 I.T.U. Mantoux test.

The discrepancy between the results of the jelly and Mantoux tests was negligible among the children under 5 years of age. Further, in this group, in which flourpaper was not used, there were very few doubtful reactions to the jelly test. In the older age groups, however, there was considerable discrepancy between jelly and Mantoux results and the proportion of doubtful reactions was higher (see Table IV).

TABLE IV.—COMPARISON BETWEEN JELLY AND MANTOUX TESTS ACCORDING TO AGE

Age Groups	*Results of Jelly Tests*		*Results of Mantoux Tests*			
	Result	*Number*	10 *I.T.U.*		100 *I.T.U.*	
			Positive	*Negative*	*Positive*	*Negative**
1-4 years	Positive	9	5	4	2	2
	Negative	102			1	101
	Doubtful	4			Nil	4
5-9 years	Positive	152	59	93	2	91
	Negative	119			5	114
	Doubtful	64			8	56
10-16 years	Positive	143	85	58	6	52
	Negative	134			22	112
	Doubtful	56			13	43

* *Carried out on cases who had already given a negative result to jelly or Mantoux* 10 *I.T.U. tests.*

In the Mantoux tests we were able to classify all the 938 results as definitely positive or negative. In addition it was found that the intradermal test was much more easily and speedily carried out. When testing a large group—as in schools—it is very much more convenient to give an injection into the forearm than to apply the jelly test with all the undressing and dressing involved.

A Mass Radiography Survey was carried out at the same time and a very close agreement was reached between the X-ray findings and the Mantoux tuberculin tests. In only one case was there some evidence of calcification due presumably to a previous tuberculous lung lesion associated with a negative tuberculin reaction to 100 I.T.U. old tuberculin.

Vaccination was performed on all who failed to react to the 100 I.T.U. Mantoux test. The fact that no accelerated reactions were produced tends to confirm the accuracy of the reading of the tuberculin tests.

Dick (1950), using flourpaper, considered that jelly testing (60 per cent. O.T.) gave results which closely approximated to Mantoux testing with 10 I.T.U. He therefore was of the opinion that the jelly test was accurate up to the age of 20 years. He did not consider that the excessive use of flourpaper resulted in any real difficulties in the interpretation of the results, provided the observer had sufficient experience in carrying out the test.

Lendrum (1951), employing various techniques in tuberculin jelly skin testing, was of the opinion that the use of flourpaper was essential if the best results were to be obtained. Using O.T. jelly he noted 98·4 per cent. agreement with Mantoux testing with 10 I.T.U. in 3,092 cases aged 4-20 years, and considered that his flourpaper technique was as efficient in the higher age groups as in the lower. He was also of the opinion that the best results would be obtained if readings were delayed beyond the seventy-two hours previously recommended.

Anderson, Grenville-Mathers and Trenchard (1951) found correlation

between tuberculin jelly and Mantoux 10 I.T.U. in 90 per cent. of 255 children tested.

Clark (1951), working in Aberdeen, found agreement in 1,440 out of 1,499 children (96·06 per cent.) when comparing the jelly test with the 10 I.T.U. Mantoux test, but gave up using flourpaper very early in his survey, considering that this caused marked reactions in some cases. He cleaned the skin with ether only and applied the jelly in the form of a blob and not a " V," which, he had noted, caused severe reactions in several previous cases. He considers that for all practical purposes jelly and Mantoux 10 I.T.U. are of equal accuracy. His group of children were in hospital and, therefore, a number probably suffered from active tuberculosis.

It is interesting to note that Robinson (1951) in a pilot survey in which flourpaper was not used found 9 per cent. positive reactors to tuberculin jelly in 522 children, whereas in a later group of 2,684 children, 498 of whom had been included in the first series of tests, and where flourpaper was used, he obtained 43 per cent. positive reactors. In view of our experience here we feel that many of these positive reactors may have been due to the difficulty in reading after using flourpaper.

Conclusions

1. The results of a tuberculin testing survey among 783 children aged 1-16 years are described.

2. The tuberculin jelly test, as described, was reliable in children under 5 years of age.

3. In children aged 5-16 years the jelly test was found to be difficult to read. Too many doubtful reactions were obtained and many of the positive results were not confirmed by subsequent Mantoux testing. A negative jelly reaction was found to give a fairly accurate indication of the absence of sensitivity (as judged by the Mantoux test results) at all ages.

4. The use of flourpaper, in spite of the fact that it was employed with the greatest care, was found to cause troublesome and uncertain skin reactions. Many of the doubtful and unconfirmed reactions reported here were, in our opinion, due to the use of flourpaper or to the adhesive plaster used to cover the jelly.

5. The Mantoux test is a simpler, quicker and more accurate method and is to be preferred in children over 5 years.

We are indebted to the Council of Management of the Orphan Homes of Scotland for permission to carry out the investigation, to Dr. J. S. M. Gray, County Medical Officer of Health, Renfrewshire, for help in carrying out the work, and to Prof. F. R. G. Heaf and Dr. A. Q. Wells for advice and encouragement.

REFERENCES

Dick, W. P. (1950): *Brit. Med. J.*, **2**, 141.
Lendrum, J. D. (1951): *Brit. Med. J.*, **2**, 148.
Anderson, Grenville-Mathers, and Trenchard (1951): *Lancet*, **1**, 116.
Clark, N. S. (1951): *Lancet*, **2**, 463.
Robinson (1951): *Brit. Med. J.*, **2**, 884.

THE PULMONARY SEQUELÆ OF ENORMOUS DILATATION OF THE LEFT AURICLE

By Norah H. Schuster

From the Royal Chest Hospital, London

Greatly dilated left auricle is not very rare and there is an excellent general account of the condition by Daley and Franks (1949) with fifteen cases of their own and one necropsy.

Many of the publications have dealt with clinical features such as physical signs, radiological diagnosis and effects of mediastinal displacements, and there are few good illustrations of specimens. This one is presented because it was possible to take photographs showing many of the characteristic points and, incidentally, the auricle is the largest ever recorded.

The pulmonary consequences of enlarged left auricle depend on direct pressure, bronchial obstruction and cardiac failure, and there is considerable diversity of post-mortem findings. Even more various are the views of radiologists on the effect of auricular enlargement on the lungs.

No attempt will be made to discuss the natural history of the disease and the clinical story will be very briefly told. I am much indebted to Dr. Courtenay Evans for sending me the case history of his patient.

Case History

At the age of 12 she had rheumatic fever, at 14 she had chorea, and at 18 she was thought to have developed auricular fibrillation and was in Highgate Hospital. At the age of 22 she was in the Temperance Hospital because of congestive failure and at 23 she had symptoms suggestive of a cerebral embolus. At the age of 24 she attended the Royal Chest Hospital and was admitted with a diagnosis of mitral stenosis, auricular fibrillation and bronchitis. During her attendance at the hospital a radiological diagnosis was made of aneurysm of the left auricle (in 1937 at the age of 25). In 1946 there was a collapse of the left lung due to greatly enlarged heart. She died in 1948 at the age of 36 of chronic congestive heart failure.

The clinical signs in the heart were an apex beat in the sixth space in the anterior axillary line, a systolic and diastolic murmur at the apex and a loud systolic murmur heard under the right breast. Rhythm was irregular owing to auricular fibrillation, the liver was constantly enlarged from 2 to 5 finger breadths, and there were signs of bronchiectasis in the left lung.

The clinical diagnosis was rheumatic heart disease, mitral stenosis, tricuspid regurgitation, giant left auricle and auricular fibrillation.

Necropsy

Pericardium is adherent over the whole heart with easily separated adhesions.

Heart lies in the normal plane and obscures part of the right and nearly the whole of the left lung.

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Right auricle lies entirely in front. It is slightly dilated and the muscle wall diminished. The auricular appendage is partially merged in the main chamber. The left auricle presses into it from behind and the inter-auricular septum is in a coronal plane.

Left auricle measures 24 inches round its widest part and holds 4 pints (2,300 c.c.) of water. It is full of fluid blood.

Seen from the front (Fig. 1) it extends well beyond the whole of the right border of the heart; on the left it extends beyond the upper part of the left border; the left auricular appendage is also dilated. The auricle can be seen bulging forward between the aorta and superior vena cava.

Seen from the back (Fig. 2) the auricle takes up the whole posterior aspect, except the apex, and the left lung appears to sit upon it. The wall is extremely thin and fibrous with recognisable muscle strands near the appendage only.

The veins enter normally allowing for the distension of the chamber.

Valves. The aortic and tricuspid valves are fibrous and somewhat rigid; the tricuspid ring is slightly contracted. The mitral valve is very hard and fibrous; it is much contracted and funnel shaped.

Aorta. The ascending part lies against the anterior wall of the left auricle and the arch is in immediate contact with the left main bronchus beneath it (Fig. 3). No atheroma.

Pulmonary artery and both main branches are wholly in front of the left auricle. They are normal in size.

Coronary arteries are healthy so far as examined.

Œsophagus is deflected rather sharply backward and to the right just behind the carina (Fig. 2). No structural change was seen in the wall.

Trachea is distorted at its lower end by being pushed backward over the dome of the auricle so that it has a bend like the neck of a swan. The two main bronchi are splayed out at an angle of 130° (Fig. 3).

Right bronchus is slightly elevated but not compressed. The upper and lower lobe bronchi are also free from obstruction, but the middle lobe bronchus is constricted at its origin and admits a probe with difficulty. Immediately distal it is dilated. Lymph glands encircle the origin but are quite small and soft. The left auricle impinges on this bronchus more than on the others, but it is impossible to be sure of the exact cause of the middle lobe collapse.

Left bronchus is elevated and points upwards (Fig. 4). Its diameter is normal, but it is quite flat for about 1½ inches, being squeezed between the aortic arch and the enlarged auricle. The membranous part of the wall is posterior.

Pleura. There are partial adhesions to the pericardium over both lungs.

Right lung. The upper and lower lobes are very congested and slightly œdematous and have many small emphysematous spaces in the substance. There is no consolidation or infarction or hæmorrhage.

Histological sections confirm, though a few tiny hæmorrhages into the alveoli were found. There is intense venous and capillary engorgement; and brown pigment macrophages but no Prussian Blue reaction. The middle lobe is completely collapsed and the principal bronchi are dilated and full of purulent secretion. No inflammatory reaction.

Left lung is small and airless, the lower lobe being the more shrunken. Both lobes consist of solid tissue traversed by dilated bronchi containing

PLATE X

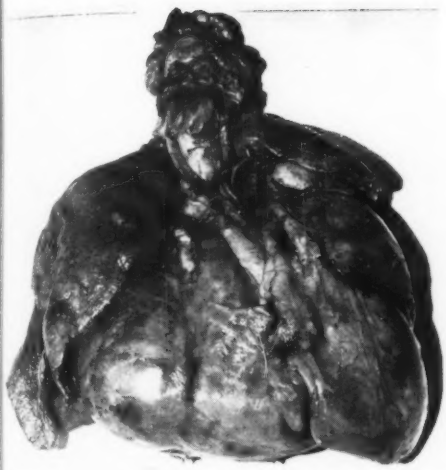

FIG. 1

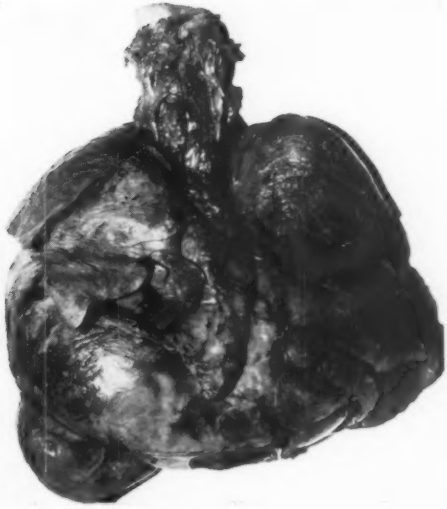

FIG. 2

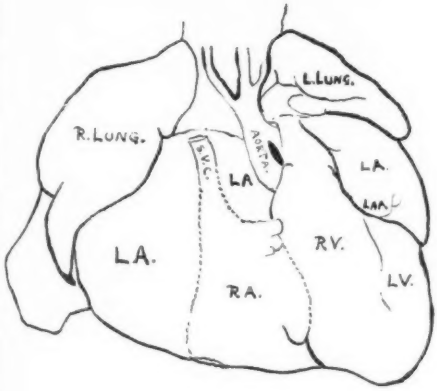

FIG. 1A

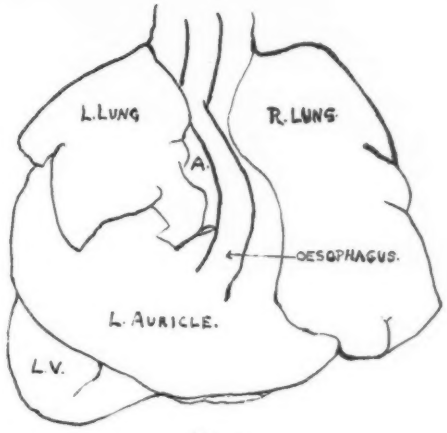

FIG. 2A

FIGS. 1 and 1A.—Anterior view. The left auricle extends to the left (L.A.). It bulges between the aorta and the sup. ven. cava. (L.A.). The right auricle is entirely in front (R.A.). The left lung is very small and high up. There is a large lymphatic gland at its root.

FIGS. 2 and 2A.—Posterior view. The œsophagus is deviated to the right. The aorta lies beside it (A).

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FIG. 3.—Posterior view. Left bronchus compressed between the left auricle and the aortic arch. Left lung. Collapse and bronchiectasis. Right lung. Passive congestion and œdema.

FIG. 4.—Posterior view. After removal of the aorta. Permanent flattening of the left bronchus. Pulmonary changes the same as Fig. 3.

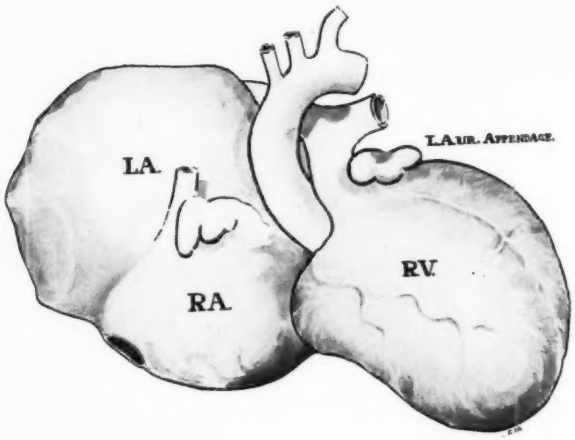

FIG. 5.—Drawing of a different specimen in the R.C.H. Museum to show the more usual changes.

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purulent secretion. The general appearance is reminiscent of congenital atelectatic and bronchiectatic lung.

Histological sections show dilated bronchi containing pus cells, but there is no evidence of active inflammation or necrosis of their walls. The small bronchioles are collapsed. Foci of an infantile type of lung parenchyma are scattered in the more solid tissue. Some carbon is present in macrophages and interstitial tissue, though less than on the other side. The vascular system seems to be fully developed and healthy except for some periarterial fibrosis. There is intense engorgement of the capillaries.

Lymphatic glands are considerably enlarged, particularly round the base of the heart and at the roots of the lungs (Fig. 1). No pressure on bronchi by glands was identified.

Left recurrent laryngeal nerve. The portion under the aortic arch appeared to be free but it had, unfortunately, been torn during dissection (there had been no evidence of nerve involvement during life).

Comment

Expansion of the left auricle. It is the general opinion that expansion proceeds backwards, to the right, and then upwards, and according to the anatomy that seems to be the path of least resistance. Bramwell and Duguid (1928) were so impressed with the right-sidedness of the dilated auricles in their series that they used the term " aneurysmal dilatation," but Daley and Franks consider this to be a mistaken conception. Only in extreme instances would the auricle extend beyond the left border of the heart and I have not found any record of a specimen so far advanced as this one. Schwedel (1946) published an X-ray photograph of one, but says that in the ordinary way " increased grades of expansion " cause greater rotation of the heart and make it less likely that the auricle will appear on the left side. According to Gaebert (1934), the right part of the auricle tends to expand forwards and the left part backwards. If so, the counter-clockwise rotation of the heart which brings the right auricle to the front might be explained. The tendency might also account for the greater distortion of the left main bronchus compared with the right.

In other respects, the pericarditis, lymphadenitis, mitral stenosis and auricular fibrosis all point to a previous pan-carditis and the probability of a rheumatic ætiology.

It should perhaps be pointed out that mitral stensis is not invariably present; it was, in fact, absent in Owen and Fenton's (1901) famous case, and so far as can be ascertained, five out of about fifty cases have not shown mitral stenosis. Bramwell and Duguid made it clear that the loss of muscle tissue is the chief cause of the dilatation.

The *Œsophagus* has received much attention from radiologists, who can now diagnose the condition from a study of the barium flow. The pioneer work was done by Gaebert (1924), Roesler and Weiss (1925), Schwedel (1946), Steele and Ralston Paterson (1928).

In this case the œsophagus suffered the common type of posterior right-hand deflection but it is impossible to say whether there had been obstruction during life as there was no permanent compression. There is no history of

dysphagia but there is an angulation which might have caused the abrupt narrowing considered by Parkinson (1936) to be essential for the radiological diagnosis of enlarged left auricle.

Trachea and Bronchi. The widening of the bifurcation angle and backward displacement of the lower end of the trachea does not seem to have obstructed it and there are no enlarged lymphatic glands to cause embarrassment at the carina.

Many interesting radiological studies have been made on bronchial distortion during life (Gaebert, Steele and Paterson, Daley and Franks, Schwedel, etc.). The photographs (Figs. 3 and 4) illustrate very beautifully the elevation and flattening of the left bronchus as seen post-mortem. In this instance I believe the flattening to be due in great measure to compression between the auricle and the arch of the aorta, and not merely to one-sided pressure from the auricle as is usually supposed. The compression is clearly from above and below in contrast with the antero-posterior flattening described long ago by King (1838) and by Taylor (1889), neither of whom stated the position of the aorta.

Stoerck (1910) published many drawings of the normal anatomy of the part and there are some observations on the aorta as a boundary of a dilated left auricle by East (1926), Shaw (1924), Lutembacher (1917), but its part in compression of the left bronchus has not been considered. It may be remarked that the right main bronchus is also in close contact with a dilated left auricle, and sometimes pushed upward, but it has never been reported to be compressed.

Bearing in mind a remarkable case of Daley and Franks in which pressure on the right middle bronchus was demonstrated by bronchoscopy, this branch was specially examined. It proved to be constricted though no particular localised pressure could be identified post-mortem.

The *Right lung* illustrated congestive heart failure; sections suggested the presence of hæmosiderin but the Prussian Blue test did not confirm it. In the middle lobe, the bronchiectasis and collapse may be taken as a consequence of the branch bronchus and it is in line with Daley and Franks' clinical observation.

In the *Left lung* the sections suggest a fairly long-standing atelectasis and bronchiectasis without infection and the presence of carbon indicates some previous respiration.

Schwedel does not believe in atelectasis by compression of a bronchus except in childhood, but I think that in this case it should be allowed because the patient had been under close observation for twenty-four years. Collapse and bronchiectasis were first noticed at the age of 34, and it is very unlikely that they would have been unrecognised ever since the early stages of the illness in her childhood.

The drawing (Fig. 5) was made from an old museum specimen for comparison as it conforms more to the usual pattern. The heart lay almost horizontally in the chest and the left auricle pointed towards the right axilla. There was much arteriosclerosis and calcification of the wall giving it the appearance of an aneurysm. There was severe mitral stenosis.

The left lung was collapsed but there is no information about the left bronchus. The right lung was much congested and had many hæmorrhages

into its substance. The patient was a woman of 39 with a history of rheumatism.

Summary

A specimen of extreme dilatation of the left auricle is described and illustrated. It is the largest ever recorded.

The specimen shows the unusual feature of extending beyond the left border of the heart.

Compression of the left main bronchus is demonstrated and it it suggested that the arch of the aorta is partly responsible.

Obstruction of the right middle lobe bronchus is described.

Pulmonary changes in the left lung, and probably also in the right middle lobe, are thought to be a consequence of the dilated left auricle.

Pulmonary changes in the right lung are ascribed to congestive heart failure.

A second specimen is illustrated for comparison.

I want to express grateful thanks to Dr. Courtenay Evans for having rescued the thoracic organs after the post-mortem had been performed elsewhere.

REFERENCES

Ashworth, H., and Jones, A. M. (1946): *Brit. Heart J.*, **8**, 207.
Bach, F., and Keith, S. (1929): *Lancet*, **2**, 766
Bedford, D. Evan (1927): *Amer. Heart J.*, **3**, 127
Bramwell, J. C., and Duguid, J. B. (1928): *Quart. J. Med.*, **21**, 187.
Cassidy, M. A. (1930): *Proc. Roy. Soc. Med.*, **23**, 955, 1275
Daley, R., and Franks, R. (1949): *Quart. J. Med.*, **43**, 81.
East, C. F. T. (1926): *Lancet*, **1**, 1194.
Emmanuel, J. G. (1923): *Lancet*, **1**, 159
Gaebert, E. (1924): *Fortschr. a. d. Geb. d. Roentgenstrahlen*, **32**, 410.
King, T. W. (1838): *Guy's Hosp. Rep.*, **3**, 175
Lutembacher, R. (1917): *Archiv. d. Mal. du Cœur*, **10**, 145.
Notkin, M. (1924): *Archiv. Int. Med.*, **33**, 71.
Owen, I., and Fenton, W. J. (1901): *Clin. Soc. Trans.*, **34**, 183.
Parkinson, J. (1936): *Lancet*, **1**, 1391.
Roesler, H., and Weiss, K. (1925): *Fortschr. a. d. Geb. d. Roentgenstrahlen*, **33**, 717.
Schwedel, J. B. (1946): *Clin. Roentgenol. of the Heart, N.Y.*
Shaw, H. Batty (1924): *Lancet*, **2**, 493.
Steel, D. (1931): *Amer. J. Roentgenol.*, **26**, 66.
Steele, J. M., and Paterson, Ralston (1928): *Amer. Heart J.*, **4**, 692.
Stoerck, O. (1910): *Ztsch. f. Klin. Med.*, **69**, 32.
Taylor, H. H. (1899): *Trans. Path. Soc., London*, **40**, 58.

AN UNUSUAL TYPE OF REACTION TO P.A.S. WITH A REVIEW OF ITS TOXIC EFFECTS

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Since para-amino salicyclic acid was introduced by Lehman in 1944 as an aid to the treatment of tuberculosis there have been a number of reports of its toxic effects.

The purpose of this paper is to describe a case with a hitherto unpublished type of toxic reaction to P.A.S., namely a leukæmoid reaction and laryngeal stridor, and to discuss the severe and dangerous side-effects of the drug which have been reported in the literature.

Case History

A man aged 58 years suffering from paraphrenia and chronic active tuberculosis at the apex of the right lung.

On 20.9.51 treatment was begun with streptomycin 1 gm. daily and P.A.S. 5 gm. t.d.s. Thirty days later he developed an allergic reaction. His subsequent progress was as follows:

20.10.51. Temp. 100·4°. A diffuse erythematous rash developed on his legs.

21.10.51. Temp. 99·4°. An erythematous maculo-papular rash covered his trunk, arms and legs and there was slight puffiness of the eyes.

Streptomycin and P.A.S. were discontinued and Antistin 100 mgm. t.d.s. commenced.

26.10.51. The rash and the œdema were now less. Antistin was continued, and the patient was given one dose (5 gm.) of P.A.S. Half an hour later he looked ill (temp. 100·8°). P.A.S. was stopped after a second dose, and the Antistin increased to 200 mgm. t.d.s.

27.10.51. Temp. 102·6°. Pulse 118/min. The patient was quite ill with a diffuse erythematous maculo-papular rash. There was severe œdema of the face and extending as far as the xiphisternum. Fitting œdema was just present on the hands. Tender enlarged lymph glands the size of pigeons' eggs were present in the neck. The liver and spleen were not enlarged.

28.10.51. Patient complained of photophobia but had no neck rigidity. Transient laryngeal stridor developed. Pruritus occurred and was partly controlled by Thephorin ointment and Thephorin 25 mgm. t.d.s., which replaced the Antistin.

29.10.51. Temp. 99°. The œdema was less and the lymph glands were smaller.

30.10.51. Fine desquamation of hands and face started. A urine sample contained a faint trace of albumin and an occasional pus cell. Blood urea 23 mgm.

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Blood Count:

W.B.C.	46,000/c.mm.
Polys	38%
Eos	31%
Lymphs	24%
Monos	1%
Primitive Cells ..	6%

The report of the blood film read thus: " The majority of the granulocytes were band forms. No myelocytes present. There are moderate numbers of immature cells of the lymphocytic series. This is a leukæmoid reaction of the granulocytic type in addition to the usual allergic response to P.A.S. therapy. Platelets and red cells normal."

3.11.51. Œdema disappeared. Desquamation extended to arms and back.

9.11.51. Hb. 95 per cent., W.B.C. 16,800/c.mm., P. 42 per cent., E. 17 per cent., L. 33 per cent., M. 8 per cent.

Eight weeks after the onset of the allergic reaction the patient was free of symptoms.

It seemed more likely that the toxic reactions were due to P.A.S. than to streptomycin, and intramuscular injections 0·05 gm., 0·2 gm., 0·5 gm. and 1·0 gm. of streptomycin were now accomplished without toxic reaction. Accordingly 0·1 gm. and 0·5 gm. of P.A.S. were given on successive days, again without signs of ill effect. However, 1·5 gm. of P.A.S. produced a transient puffiness of the face and a faint macular rash. There was no elevation of temperature and no change of blood picture. It seems therefore that the allergic type of reaction was due to P.A.S. and not to streptomycin.

Despite the severe systemic disturbance neither the paraphrenia nor the tuberculous condition was affected adversely.

Discussion

The side effects of P.A.S. can be divided broadly into immediate signs of intolerance and toxic allergic reactions. Of the former the M.R.C. (1950) found that gastro-intestinal symptoms (nausea, vomiting and diarrhœa) occurred in 58 per cent. of their cases.

Toxic Reactions

Toxic reactions are less common, but many reports have now been published showing the diverse ways in which a P.A.S. reaction may manifest itself.

Skin Reactions

By far the commonest form is a skin reaction with a more or less typical course. The incidence is hard to assess, but the reports of P.A.S. in the treatment of tuberculosis by Nagley and Logg (1949), the M.R.C. (1950) and Madigan *et al.* (1950) dealt with 160 cases of which seven had skin reactions. In these reactions [a typical series was reported by Keirland and Carr (1950)] the patients had received P.A.S. for three or four weeks, then suddenly developed a temperature followed by a generalised pruritic macular papular rash. If P.A.S. was discontinued the temperature subsided rapidly and the rash was followed by a desquamation of the skin. A few cases (Thorne, 1951) have developed urticaria or angio-neurotic œdema of the face and limbs.

Grandjean (1951) reported a case of complete temporary alopœcia in a patient who received P.A.S. for thirty-one days and then developed a toxic reaction with jaundice, exfoliation and loss of hair.

Renal Disturbances

Urinary disturbances are not an uncommon feature. Albumin has been reported frequently either as part of a general disturbance or as the sole reaction. Besides this Nagley and Logg (1949) reported four cases of hæmaturia as well as albuminuria in patients receiving P.A.S. Normoglycæmic glycosuria has been reported by Keleman *et al.* (1949), but of more serious import is anuria, reported by Cuthbert (1950) and Livingstone *et al.* (1950).

Respiratory Disturbances

Respiratory disturbances are few, but Gerrits (1951) reported two cases of asthma following the administration of P.A.S. for four weeks. The drug proved to be the causal factor. Cases of intractable cough have been reported by Horne (1949), and Hemming and Stewart (1949). Laryngeal stridor occurred in the author's case, but no similar occurrence has been reported.

Gastro-intestinal Reactions

Disturbances of the gut are usually due to intolerance, but toxic reactions do occur, usually in the form of pharyngitis. Thorne (1951) had a case with inflamed sub-mandibular and parotid glands as well as other signs.

Hypokalæmia, Paralysis and Cardiac Arrhythmias

Heard *et al.* (1950), Cayley (1950), Strong (1951) and Roussak (1952) have reported cases of palsy, tetany or cardiac arrhythmias occurring during P.A.S. therapy and attributed to hypokalæmia. Of nineteen cases reported, the thirteen cases whose serum potassium level was investigated showed values below 15·5 mgm./100 ml. Seven of these thirteen cases developed a transient palsy, which disappeared as the serum potassium rose to normal levels. On the other hand, six cases with hypokalæmia showed no evidence of palsy or tetany, so that relationship between low serum potassium levels and palsy is not direct. Hypokalæmia due to P.A.S. therapy may be a serious condition, for Heard *et al.* (1950) reported a fatality due to a rapidly ascending paralysis of limbs and trunk in a patient on P.A.S., which they attributed to hypokalæmia. The authors had a sudden death in a patient who had a serum potassium level of 12·5 mgm./100 ml. Roussak (1952) reported a case of T.B. meningitis who developed a fatal hypokalæmic alkalosis with tetany while receiving P.A.S.

In these cases of hypokalæmia the possibility of other unusual factors has been suggested, such as liquorice extract used for flavouring P.A.S., the sodium radical and also streptomycin. This has been investigated by Campbell and Neufield (1951), who found that mild hypokalæmia followed the administration of sodium and potassium P.A.S., while the addition of streptomycin and liquorice extract did not produce any significant change.

Apart from the above cases, neurological reactions have been few. Thorne (1951) reported tinnitus and dimness of vision. Hemming and Stewart (1949)

described photophobia and drowsiness in one case, but these symptoms were a minor part of a severe systemic disturbance.

Hæmopoietic Disturbances

The hæmopoietic system has, as would be expected, shown many different types of reponse in toxic reactions. Purpura has been described by Secousse (1950) in three cases, but little detail was given of the blood picture. Swanson (1949) and many others have reported a fall in the prothrombin level down to 60-70 per cent. of normal, but none below 50 per cent. In one case (Thorne, 1951) the blood platelets fell to 105,000 and Hess's test became positive in the course of a severe generalised reaction. Splenic enlargement is uncommon, but Moschini and Cricchio (1949) reported two cases of transient splenomegaly and hepatomegaly, but no jaundice. Enlargement of lymph nodes has been noted, frequently occurring shortly after a generalised erythematous skin reaction, the lymph nodes swelling to the size of pigeons' eggs before disappearing. Eosinophilia has been a very common accompaniment of toxic reactions. Usually it is in the nature of 10-20 per cent. of the white cells, but it has been as high as 30 per cent.—*e.g.*, Livingstone and the present case. Leucocytosis occurs in many allergic reactions and frequently rises to 12-20,000/cm. or over in the severest reactions. A case was reported by Fullerton (1951) when there was 3 per cent. metamyelocytes in the peripheral blood out of a total white count of 14,200/cm. Otherwise, no published reports, apart from the present case, have mentioned the presence of immature cells in the peripheral blood.

Leucopenia and anæmia are less common in P.A.S. allergic reactions and have not been of any severity, except in one fatal case reported by Loubeyre and Farkas (1951). They described a death from aplastic anæmia and hæmolysis apparently due to P.A.S. The patient developed a generalised skin reaction and pyrexia fifteen days before P.A.S. was stopped. A sternal puncture showed absence of erythroblasts and few polymorphs with an increase of abnormal metamyelocytes. After ten days, during which time he received 3 pints of blood, the R.B.C.'s were 1,400,000 per c.mm. and W.B.C.'s 1,600 per c.mm. He died after eleven days without a post-mortem being performed.

Jaundice

By far the most serious type of allergic reaction is toxic jaundice. This has been reported many times, and up to the time of publication the writer has been able to collect nineteen cases in which jaundice was ascribed to P.A.S. This excludes two cases of hepatomegaly without jaundice. All the reports which have given details show that P.A.S. has been administered for more than eighteen days and that a minimum of 163 gm. has been necessary to produce jaundice. All but three of the twelve cases described have had prodromal signs such as pyrexia, rash in seven cases, malaise or anorexia for some days before P.A.S. has been incriminated as the causative agent for the signs. Frequently jaundice has appeared before the illness has been recognised as a toxic reaction, so that many cases have had several days' treatment with P.A.S. after becoming allergic to the substance.

Cuthbert described a case where the patient received P.A.S. for eleven days

after showing the first signs of toxicity. This patient developed severe jaundice, later becoming comatose and anuric. He recovered slowly and was desensitised successfully at a later date. Landsborough (1951) reports a case which received P.A.S. for thirteen days after the first signs of toxicity. The patient developed a typical P.A.S. rash, followed by a deep jaundice which progressed until the patient became comatose and died.

Other cases—Hurrell (1950), Hess and Ismay (1950), Grandjean (1951)—have been reported in which the drug has been stopped immediately any signs of toxicity have appeared, but this has not prevented the jaundice appearing, together with a classical rash and subsequent desquamation of skin.

To prevent all cases of jaundice due to P.A.S. appears impossible, but on comparing case records it is obvious that the severest cases have had P.A.S. for many days after showing signs of toxicity. The most severe conditions can be avoided by stopping P.A.S. as soon as any allergic condition occurs and administering antihistaminics and applying antihistaminic cream when appropriate. This means that one must be aware of the comparative frequency and the diversity of the toxic reactions due to P.A.S.

Conclusions

In the discussion a review of the toxic reactions due to P.A.S. was made and some of the cases were described briefly. It is obvious that P.A.S. causes a diversity of toxic reactions in people who are receiving the drug. Many of these reactions, which range from skin eruptions to jaundice and hypokalæmia can be dangerous and are on occasions lethal. Of the five fatalities reported, one was due to hypokalæmic alkalosis, another to aplastic anæmia; of the remaining three, one was due to toxic jaundice, one to ascending paralysis and the last, a sudden death, attributed to hypokalæmia.

In view of all these side-effects to P.A.S. it is evident that it is a potentially harmful drug although of undoubted value in the treatment of tuberculosis. While toxic reactions are not of such frequent occurrence as to merit the withdrawal of P.A.S. therapy from the treatment of tuberculosis, it is suggested that the drug be given with more caution than at present, for the majority of severe reactions have been due to the continued administration of P.A.S. after toxic signs have occurred.

Summary

1. A case of toxic reaction due to P.A.S., with a leukæmoid blood picture and stridor, is described.

2. A review of toxic reactions due to P.A.S. is given.

I wish to express my thanks to Professor H. Scarborough, and Wing-Commander O'Connor for their advice and criticism; to Dr. Caldwell, consulting pathologist, for his report on the blood counts; and to Dr. Ström-Olsen, for his advice and his permission to publish the case report.

REFERENCES

Campbell, A. H., and Neufield, O. E. (1951): *Med. J. Austr.*, **1**, 725.
Cayley, F. E., de W. (1950): *Lancet*, **1**, 477.
Cuthbert, J. (1950): *Lancet*, **2**, 209.
Fullerton, J. M., Hayden, P. J., Pritchard, E. K. (1951): *Lancet*, **2**, 941.
Gerrits, J. C. (1951): *Geneesk Gids*, **29/9**, 169.
Grandjean, L. G. (1951): *Ugeskr. Laeg.*, **113/3**, 83.

HEARD, K. H., CAMPBELL, A. H., HURLEY, J. J., and FERGUSON, E. (1950): *Med. J. Austr.*, **2**, 606.
HEMMING, M., and STEWART, C. J. (1949): *Lancet*, **2**, 175.
HESS, E., and ISMAY, D. G. (1950): *Lancet*, **2**, 456.
HORNE, N. (1949): *Lancet*, **2**, 348.
HURRELL, G. (1950): *Brit. Med. J.*, **2**, 729.
KELEMAN, E., and HALMAGYI, D. (1949): *Lancet*, **2**, 348.
KEIRLAND, R. R., and CARR, D. T. (1950): *Proc. Mayo Clin.*, **24**, 539.
LANDSBOROUGH, D. (1951): *Brit. Med. J.*, **1**, 884.
LIVINGSTONE, R., and STREET, E. W. (1950): *Lancet*, **2**, 308.
LOUBEYRE, M. J., and FARKAS, E. (1951): *Algerie Med.*, **55**, 857.
MADIGAN, D. G., GRIFFITHS, L. L., LYNCH, M. J. G., BRUCE, R. A., KAY, S., and BROWNLEE, G. (1950): *Lancet*, **1**, 239.
MOSCHINI, M. and CRICCHIO, D. (1949): *Letta. c. la Tuberculosi*, **19**, 436.
M.R.C. (1950): *Brit. Med. J.*, **2**, 1073.
NAGLEY, M. N., and LOGG, M. H. (1949): *Lancet*, **1**, 913.
ROUSSAK, N. J. (1952): *Brit. Med. J.*, **1**, 360.
SECOUSSE, H., TESSIER, R., SECOUSSE, J. P., and PENE, P. (1950): *Rev. de la Tuberc. Paris*, **14**, 744.
STRONG, J. A. (1951): *Brit. Med. J.*, **2**, 998.
THORNE, M. G. (1951): *Lancet*, **1**, 1018.

FRIEDLÄNDER LUNG ABSCESS

TREATMENT BY EARLY SURGICAL DRAINAGE

By K. M. Shaw

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In 1948 Smith stressed the appalling mortality of lung abscess, and in an analysis of 1,750 cases from various authors reported a mortality of 32·7 per cent. of surgically treated and 34·7 per cent. of medically treated cases. He deplored the fact that cases only came to surgery when medical measures failed—that is, when the optimum time for drainage had also passed. Reported series of surgical drainage in the acute stage showed greatly improved figures. Neuhof and Touroff (1942) had 122 cases which were drained within six weeks with only 4 (3·3 per cent.) deaths; Lindskog (1944) had 22 cases with 4·5 per cent., and Overholt and Rumel (1941) 35 cases with 6 per cent. mortality, when drained within six to eight weeks of onset. Touroff *et al.* (1950) followed 115 cases, treated by drainage, for five to twenty-five years and found evidence of permanent lung damage in only 13 per cent. Thus, in recent years, it was becoming increasingly apparent that if improvement was to take place it was necessary for physician and surgeon to co-operate in providing *early* drainage in those cases which did not show progressive and uninterrupted resolution.

The dramatic results of penicillin therapy appeared to resolve the problem in a different way and, at the same time, advance in thoracic surgical technique rendered lung resection for residual disease practicable and safe. Sellors (1950), advocated conservative treatment with penicillin but stressed the necessity for high-level dosage of 2 million units daily, and Sutherland and Grant (1950), reviewing a series of 32 consecutive lung abscesses at the London Chest Hospital, found that 18 had the ideal treatment of intensive postural drainage and physiotherapy, combined with high-level (2 million units daily) penicillin, with 15 (83 per cent.) cures, 3 cases becoming chronic and requiring further treatment. No lung abscess had been surgically drained for two years, and recent search of the records at the London Chest Hospital reveals that no case has been drained in the past five years. Sutherland and Grant concluded that there was no place for external drainage in the treatment of lung abscess; a provocative statement which appears to be vindicated by the greater part of the current literature in which most authors favour chemotherapy, reserving surgery for the definitive resection of recalcitrant lesions which fail to show resolution after prolonged conservative treatment; these latter form a group which, under ideal circumstances, probably constitute not more than 20 per cent. of the total number. Drainage is rarely mentioned except to stress its high mortality and prolonged morbidity, which often amounts to permanent invalidism.

It would, however, be a mistake to discard drainage out of hand as an

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PLATE XII

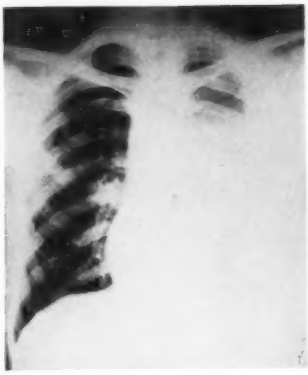

FIG. 1A

FIG. 1B

FIGS. 1A and B.—Case 1. 30.12.51. Dense homogeneous opacity in P.A. and lateral views. Shrapnel visible in left upper lobe.

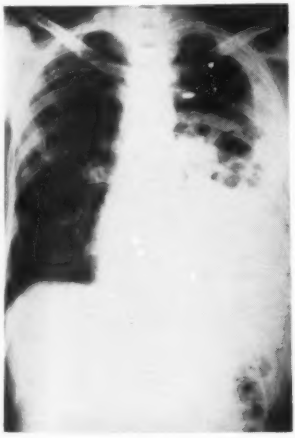

FIG. 2A

FIG. 2B

FIGS. 2A and B.—Case 1. 9.1.52. Extensive cavitation in left lower lobe.

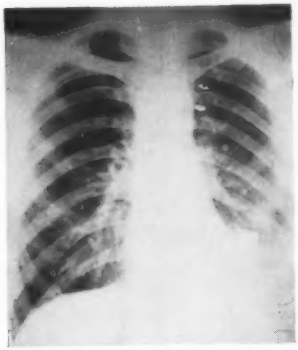

FIG. 3.—Case 1. 5.3.52. Tube in small residual abscess cavity.

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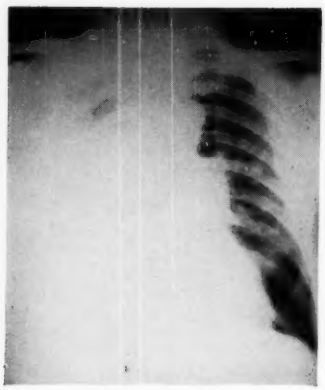

FIG. 4.—Case 2. Dense homogeneous opacity in right chest at first admission to hospital.

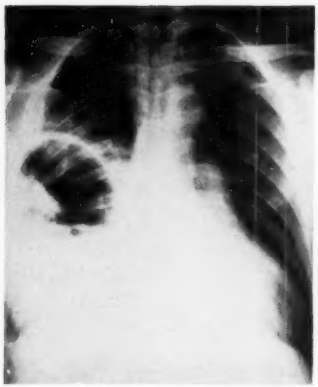

FIG. 5A

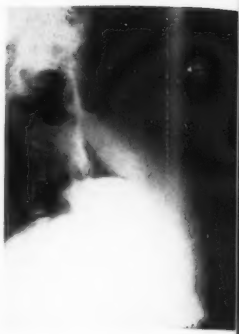

FIG. 5B

FIGS. 5A and B.—Case 2. Large cavities with fluid levels in right middle and lower lobes. Mediastinum displaced to left.

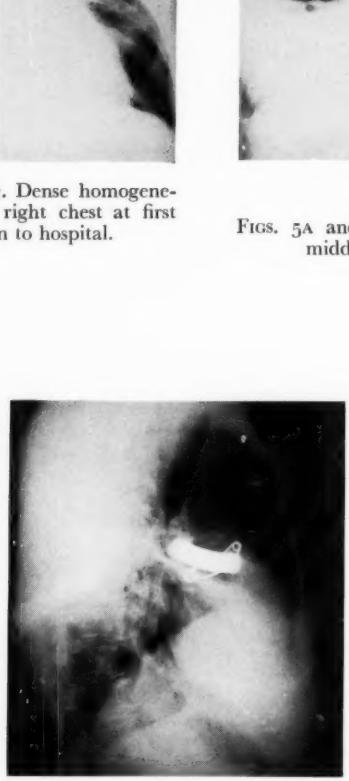

FIG. 6A

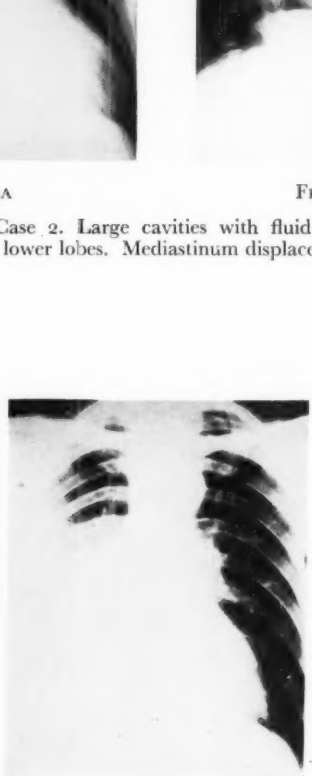

FIG. 6B

FIGS. 6A and B.—Position after one month of drainage. Small residual pockets with drainage tubes in situ.

To face p. 85

obsolete measure. Brock (1952) advances a strong plea for its employment as an early measure in certain cases. Neuhof and Touroff (1942) described a hyperacute form of abscess. They stated that the ordinary acute abscess cannot be diagnosed by radiology alone, but that the hyperacute variety shows a large cavity with a fluid level, and frequently has a serrated border signifying massive slough formation. Three of their 4 deaths occurred in 38 of this variety in their series of 122 cases. In a late review of the same series Touroff *et al.* (1950) recommend chemotherapy, but conclude that the hyperacute form should be treated by early surgical drainage.

Two cases of lung abscess are presented which indicate that, despite advances, drainage is still occasionally an inescapable necessity. Each follows the classical course of the rare Friedländer pneumonia proceeding to abscess formation, the special characteristics of which render conservative measures ineffective and radical surgery inappropriate.

CASE 1

On 23.12.51 an accountant aged 37 who had had no previous chest illness, apart from a shrapnel wound of the left chest in 1940, developed an acute febrile illness with a productive cough, severe dyspnœa and pain in the left chest. On admission to hospital he was profoundly prostrated and X-ray showed a homogeneous opacity in the left hemithorax (Fig. 1 a, b). He was coughing several ounces of sputum daily. On a diagnosis of lobar pneumonia with effusion he was treated with penicillin. Aspiration of the chest produced a few c.cs. of bloodstained fluid which was sterile on culture. X-ray several days later showed air spaces and a fluid level in the area of the former opacity, and he was transferred to the Thoracic Surgical Unit at the Brook Hospital with a diagnosis of lung abscess. On admission he was desperately ill with a hectic fever, tachycardia and dyspnœa. There was no gross dental sepsis. He still had several ounces of thin, brownish, frothy, odourless sputum daily, with a mixed culture, chiefly *Strep. viridans*. X-ray showed a large cavity with a fluid level in the left chest (Fig. 2 a, b). At bronchoscopy, reddening of the left bronchial tree, most marked in the apical bronchus of the lower lobe, was seen.

He was treated with penicillin, 2 million units, and aureomycin, 2 gm. daily, with some clinical improvement, but no radiological change. The diagnosis of lung abscess was not certain and the possibility of empyema was considered. Aspiration of the chest (11.1.52) produced 4 oz. of dark brown thick pus which was sterile on culture.

In view of the failure of the abscess to show any resolution he was given a course of chloromycetin, and his clinical condition improved dramatically over the next week; his temperature became normal and he felt well apart from cough and some dyspnœa. There was still, however, no radiological improvement. Accordingly on 22.1.52 the abscess was drained under local anæsthesia through a posterior incision with resection of portions of the eighth and ninth ribs. The pleural space being obliterated, the abscess was unroofed by resecting a disc of lung over the cavity. Yellow pus was evacuated which on culture gave a pure growth of an organism of the Friedländer-aerogenes group. Festoons of grey slough hung free in the cavity and attached to its walls, and these were excised as far as possible. The cavity was packed with flavine gauze. Following this the patient felt well and lost his cough and dyspnœa. The cavity became very small (Fig. 3) but could not be induced

to heal, and a bronchogram (5.5.52) showed the apical lower lobe bronchus leading directly into the abscess cavity, the rest of the bronchial tree being virtually normal. On 12.5.52 a left lower lobectomy was performed and the sinus excised. Recovery was uneventful apart from some infection of the old tube track which produced a small basal empyema requiring tube drainage for several weeks. The patient is now fit and back at work.

Comment.—Primary resection of the lower lobe was considered as an alternative line of treatment. The possibility of an empyema with bronchopleural fistula had not been entirely excluded, and the patient's general condition always gave some anxiety. On final review, it is hard to escape the conclusion that drainage was the correct course. The shrapnel retained in the lung was well clear of the abscess and did not appear to be of any etiological significance.

CASE 2

On 6.2.52 a lorry-driver aged 46 was admitted to hospital seven days after the onset of a severe febrile illness with productive cough, marked dyspnœa and pain in the right chest. He had had a chronic cough for many years. His sputum became bloodstained and he had several small hæmoptyses. He was profoundly ill with a hectic fever and on a diagnosis of lobar pneumonia with effusion he was treated with penicillin, with some clinical improvement. X-ray (Fig. 4) showed a dense opacity of the right hemithorax with mediastinal shift to the left. Aspiration of the chest produced 10 oz. of reddish-brown pus which grew a coliform bacillus on culture. X-ray following this showed large air spaces and fluid levels, although care had been taken at aspiration to prevent any air entering the chest. A course of chloromycetin produced some clinical improvement but no radiological change, and he was transferred to the Thoracic Surgical Unit, Brook Hospital, as a case of lung abscess.

On admission he was still toxic and very markedly dyspnœic, and was coughing several ounces of watery odourless sputum daily. There was no gross dental sepsis. X-ray (Fig. 5 *a*, *b*) showed a very large air space and the lateral film showed two fluid levels, one anterior and one posterior. Culture of the sputum produced an almost pure growth of Friedländer-aerogenes bacillus. Bronchoscopy was negative.

On 29.2.52 the abscess was drained under local anæsthesia by resection of a portion of the fifth rib in the axillary line. The pleura was adherent and bulged under tension. On opening the abscess with the diathermy knife, gas escaped under tension and this ignited with a blue flame: green pus was evacuated which grew *B. coli* on culture. Large masses of slough were removed and the cavity was packed with gauze. The large posterior pocket was thought to communicate, so no further procedure was attempted at this stage. Clinical improvement was dramatic and the dyspnœa disappeared. X-ray, however, showed that the posterior abscess was not draining, and a week later the same procedure was carried out through a posterior incision, resecting a portion of the ninth rib. Following this, convalescence was uninterrupted, though necessarily very slow. He was discharged with two tubes *in situ* (Fig. 6 a, b) and the sinuses were not finally healed until the end of June. He was then symptom free but a bronchogram on 29.5.52 showed virtual destruction of the right middle lobe, and of the apical segment of the lower lobe. The patient is now back at work and symptom free.

Comment.—Drainage was clearly indicated as a life-saving emergency. In spite of apparent cure in this case, the permanent lung destruction as shown by bronchograpny is a potential source of recurrent infection.

Discussion

These cases clearly correspond to Neuhof and Touroff's hyperacute variety of abscess. They might be termed giant lung abscesses. Certainly there appears to be a clear-cut distinction in quality from the ordinary abscess. Profound toxæmia and prostration and massive gangrene of lung tissue denote an overwhelming infection, and the lack of adequate bronchial drainage is demonstrated by persistent fluid levels, and by the striking difference in the character of the sputum and the abscess contents. This lack of bronchial drainage may, by allowing high intra-cavitary tension to develop, be an additional factor producing gangrene and toxæmia. These patients were obviously not coughing up their abscesses. The clinical, radiological and pathological course was characteristic of the fulminating pneumonia due to the Friendländer bacillus. Solomon (1937) collected 32 cases of Friedländer pneumonia with a mortality of 97 per cent. He stressed the prostration, frequency of abscess formation, and the character of the sputum which he termed " bloody mucus." At autopsy large cavities with massive gangrene were demonstrated. Wylie and Kirschner (1950) showed a reduction in mortality to 18·7 per cent. of 16 cases by a combination of chemotherapy and surgery, most cases requiring early drainage and subsequent resection.

It is submitted that the cases described fully vindicate Brock's insistence on the use of drainage as an *urgent* measure in acute abscesses which fail to show progressive and uninterrupted resolution with suitable chemotherapy and adequate postural drainage. No amount of bronchial drainage can be expected to deal with large gangrenous sequestra, such as were present in these cases. The time of waiting should be measured in days, not weeks (Brock). Resection as a primary measure was a formidable prospect in Case 1, and out of the question in Case 2. The ignition of inflammable gas in Case 2 was an interesting and startling complication.

Conclusion

It is to be expected that hyperacute forms of abscess will be of rare occurrence owing to advances in antibiotic therapy, but they will inevitably occur from time to time. The relative frequency of abscesses due to the Friedländer bacillus might be expected to increase as more cases are salvaged during the pneumonic stage by chemotherapy. External drainage does not preclude the possibility of later definitive resection, as Case 1 shows, but it brings the patient to resection in more or less ideal circumstances, rather than as a desperate emergency. In elderly subjects, or in those in whom advanced pulmonary or cardiac disease would make eventual resection an unjustifiable hazard, it is more than usually important not to persist in conservative treatment until the optimum time for drainage has passed, as a situation should not be allowed to arise where there is no alternative to external drainage of a *chronic* abscess.

Summary

(1) Current therapy of lung abscess is briefly discussed.

(2) Treatment by surgical drainage as an urgent measure in certain cases is advocated.

(3) Two cases are described of Friedländer pneumonia proceeding to abscess formation in which surgical drainage was successfully employed.

These cases were under the care of Mr. A. H. M. Siddons, to whom I am indebted for permission to publish their case histories.

REFERENCES

BROCK, R. C. (1952): "Lung Abscess," Oxford.
LINDSKOG, G. E. (1944): *Surgery*, **15,** 783.
NEUHOF, H., and TOUROFF, A. S. W. (1942): *J. Thorac. Surg.*, **12,** 98.
OVERHOLT, R. H., and RUMEL, W. R. (1941): *New England J. Med.*, **224,** 441.
SELLORS, T. H. (1950): "Penicillin," 2nd edition, ed. Sir A. Fleming.
SMITH, D. T. (1948): *J. Thorac. Surg.*, **17,** 72.
SOLOMON, S. (1937): *J.A.M.A.*, **108,** 12.
SUTHERLAND, A. W., and GRANT, L. J. (1950): *Lancet*, **1,** 530.
TOUROFF, A. S. W., NABATOFF, R. A., and NEUHOF, H. (1950): *J. Thorac. Surg.*, **2,** 2.
WYLIE, R. H., and KIRSCHNER, P. A. (1950): *Am. Rev. Tuberc.*, **61,** 465.

ANGIOCARDIOGRAPHY IN RELATION TO INTRA-THORACIC DISEASE

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Angiocardiography is now a well-established method of investigation, the first attempts having been made by Forssmann(1929), who injected uroselectan through a ureteric catheter which he had passed into his own right auricle via an antecubital vein. The foundations of modern angiocardiography were laid by Robb and Steinberg (1939), who showed that it was possible to demonstrate with safety the heart and great vessels by the rapid intravenous injection of a sufficient quantity of 70 per cent. diodone.

In our view the primary value of angiocardiography lies in the field of congenital heart disease, but it may give valuable help in certain types of acquired disease of the heart and great vessels, and in certain other intrathoracic disorders. Congenital heart disease is beyond the scope of this review, in which we shall deal briefly with other types of intrathoracic disease, referring only to venous angiocardiography, and omitting the more complicated methods of aortography and selective pulmonary arteriography. It is important to realise that angiocardiography is essentially an investigation which is complementary to full clinical and radiological assessment in every case.

Techniques

There are many variations in technique, but all rest upon the same general principles, which consist of the rapid injection of a sufficient quantity (not less than 1 c.c. per kgm. body weight) of 70 per cent. diodone into an antecubital or innominate vein, or into the superior vena cava. Rapid serial X-ray exposures at one-half to one second intervals are made, using either separate cassettes in a manually operated or mechanical serial cassette changer, or using a photofluorographic camera (Dotter, Steinberg and Temple, 1949; Ramsey *et al.*, 1949).

We have used the manually operated cassette tunnel designed by Macgregor (1949), and more recently a mechanically operated table which affords simultaneous exposures in two planes at right angles. General anæsthesia is essential in children and valuable in adults, since it appears to reduce the severity of the general reaction to diodone, and prevents movement during the injection. A preliminary test for diodone sensitivity is necessary, preferably by means of an intravenous injection of 2 c.c. of the contrast medium: salivation, nausea, vomiting, coughing, increase in pulse rate, are contra-indications to the investigation until the patient has been desensitised.

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Results of Angiocardiography

1. *Lesions of the Mediastinum*

The importance of angiocardiography lies mainly in differentiating anomalies of the great vessels from non-vascular tumours. As is well known, it is not always possible to differentiate between direct and transmitted pulsation on fluoroscopy, so that an aneurysm of the aorta or pulmonary artery may be closely simulated by a mediastinal tumour. In some cases the diagnosis can only be made by angiocardiography, and this investigation may save the patient an unnecessary operation or indicate removal of a tumour previously thought to be an aneurysm. Advances in the surgery of the heart and great vessels have accentuated the importance of angiocardiography, since the surgeon desires not only the diagnosis but also accurate anatomical information regarding the lesion, in order to plan his operation.

1. *The Aorta.*—In the majority of cases the investigation differentiates aortic from non-vascular shadows with ease (Sussman, 1947) and also distinguishes clearly between aneurysm and unfolding of the aorta: the latter differentiation is of considerable importance in view of recent advances in the surgery of aortic aneurysm (Poppé *et al.*, 1946; Blakemore, 1951; and Berman and Hall, 1952).

Steinberg *et al.* (1949) have described the detailed appearances of unfolding of the aorta, of aneurysm, and of dilatation, due to syphilis. An unfolded aorta may simulate an aneurysm in the anterior view on fluoroscopy, and its margins may not be easy to define in the lateral and oblique projections. Fig. 1 shows such a case in which the contrast medium clearly outlines the aorta and reveals its tortuosity and unfolding. When an aneurysm is present, the sac is outlined by the opaque medium in nearly every case, although difficulty may occasionally arise when the sac is thrombosed and fails to fill; usually, however, even in these cases at least a trickle of dye is seen to enter it. Fig. 2 illustrates a radiograph of the chest in which a shadow lies behind the left cardiac border: the angiocardiogram (Fig. 3) shows it to be an aneurysm of the descending aorta.

Aneurysms of the root of the aorta involving the sinuses of Valsalva may be undiagnosable without angiocardiography, since the shadow lies within the cardiac contour (Dotter and Steinberg, 1951[1]). Dissecting aneurysm is sometimes a difficult problem in diagnosis, and angiocardiography may provide the solution where other methods have failed.

Although an aneurysm may often be diagnosed with ease by clinical examination and fluoroscopy, accurate delineation of its extent and size is essential to the surgeon before operation.

Aneurysms of the innominate, carotid or subclavian arteries produce shadows at the root of the neck, and in this site may closely simulate non-vascular tumours such as retrosternal thyroid, and thymoma, etc.

2. *Pulmonary Artery.*—Angiocardiography affords detailed information about the anatomy of the pulmonary artery and its branches. Aneurysmal dilatation of the main trunk or its main branches can sometimes be hard to distinguish from a mediastinal tumour or lymphadenopathy. Pulsation may be transmitted to a non-vascular lesion, thus simulating an aneurysm, or an aneurysmal

FIG. 1

FIG. 2

FIG. 3

FIG. 1.—Oblique angiocardiogram. The dilated, tortuous thoracic aorta is clearly outlined by the contrast medium. (8 *sec. film.*)

FIG. 2.—A well-defined opacity behind the left cardiac border, suggestive of an aneurysm of the thoracic aorta. (6 *sec. P.A. chest film.*)

FIG. 3.—Same patient as Fig. 2. The aneurysm of the thoracic aorta is well defined by the contrast medium. (9 *sec. angiocardiogram.*)

FIG. 4.—A.P. angiocardiogram. Patient with mitral stenosis and pulmonary hypertension. The enlarged main pulmonary arteries are outlined by the contrast medium. *Note*, by contrast, the narrowed and somewhat irregular peripheral pulmonary vessels, particularly in the lower zones. (7 *sec. film.*)

FIG. 5.—A.P. angiocardiogram. An upper mediastinal mass on the left side is seen to lie between the opacified aorta and the left main and upper lobe pulmonary branches. (8 *sec. film.*)

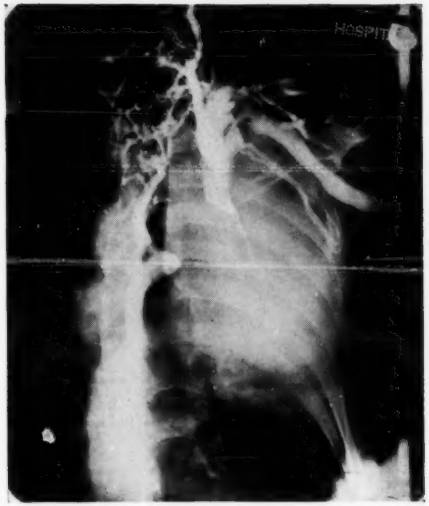

FIG. 6

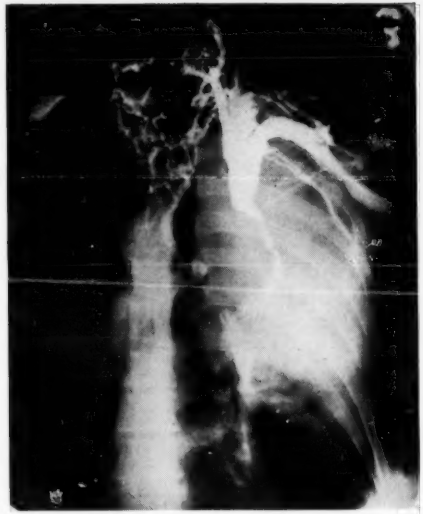

FIG. 6A

FIG. 6.—P.A. angiocardiogram. Demonstrates complete obstruction of the superior vena cava by carcinoma of the bronchus, and an extensive collateral circulation in the upper mediastinum, draining into the azygos vein. (3 *sec. film.*)

FIG. 6A.—P.A. angiocardiogram. Same patient as Fig. 6, after three weeks' treatment by deep X-ray therapy. The superior vena caval obstruction has been partly relieved and some contrast medium is seen to drain into the right auricle. (3 *sec. film.*)

FIG. 7.—Demonstrates a smooth, well circumscribed upper mediastinal mass on the right side. (*A.P.* 6 *sec. film.*)

FIG. 7A.—Oblique angiocardiogram. Same patient as Fig. 7. Shows a normal main pulmonary artery. The mass is seen to lie above the bifurcation of the main pulmonary artery. (3 *sec. film.*)

FIG. 7B.—Oblique angiocardiogram. The aortic arch is opacified by the contrast medium. The mass lies above the aorta. It does not opacify and is, therefore, not a vascular tumour.

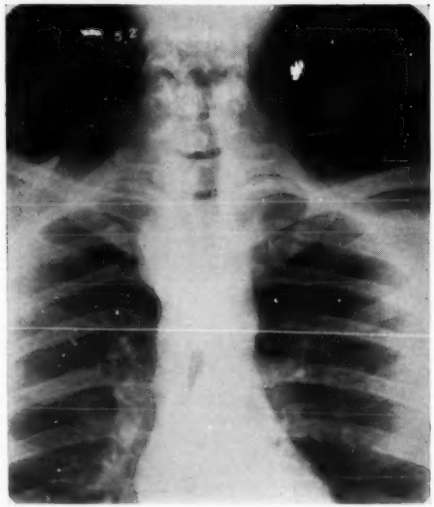

FIG. 7

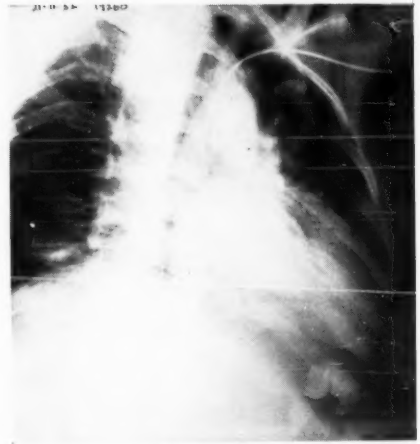

FIG. 7A

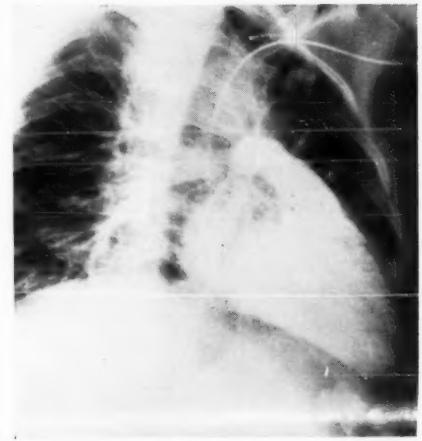

FIG. 7B

pulmonary artery may fail to pulsate owing to partial thrombosis; interruption of the flow of contrast medium can then be seen, and in any event the shadow is easily differentiated from a mediastinal tumour by angiocardiography.

Angiocardiography also reveals changes of considerable importance in the lesser branches of the pulmonary artery in certain diseases. In mitral stenosis with pulmonary hypertension these vessels are narrowed and tortuous, in marked contrast to the enlargement of the main trunk and its two main branches (Fig. 4) (Goodwin *et al.*, 1952; Angelino and Actis-Dato, 1952). The main pulmonary artery and the right ventricle are commonly enlarged in all types of pulmonary hypertension, and narrowing of the lesser branches may also occur. The enlargement of the main pulmonary arteries, although not of aneurysmal degree, may cause difficulty in interpretation of the plain radiograph.

Arteriovenous fistula of the lung can sometimes be diagnosed clinically and by plain radiography, but not infrequently presents a difficult problem. Angiocardiography confirms the vascular nature of the tumour and demonstrates the afferent and efferent vessels. It may also detect the lesion when this is obscured by the heart shadow in plain films, and is an essential investigation in any individual with central cyanosis of obscure origin and murmurs over the lung fields. The condition is usually readily amenable to surgery, and knowledge of the exact anatomy is of value to the surgeon prior to operation: moreover, since multiple aneurysms are not infrequently present, angiocardiography may detect hitherto unsuspected lesions (Baker and Trounce, 1949; Crane *et al.*, 1949; Yater *et al.*, 1949; Talbot and Silverman, 1952).

Although angiocardiography has been employed in cases of generalised pulmonary emphysema (Robb and Steinberg, 1940), it is of more value in elucidating obscure radiological changes suggesting localised emphysema. In one such case studied by us, increased translucency of the left lung, with diminished vascular markings, suggested unilateral emphysema, for which no cause could be found. Bronchoscopy did not reveal any abnormality, and respiratory function tests were not confirmatory of emphysema. Angiocardiography demonstrated aplasia of the left main pulmonary artery and its branches, thus accounting for the radiological appearances.

3. *Mediastinal Tumours.*—Benign tumours tend to displace and compress neighbouring vascular structures and air passages, and only occlude them if the tumour reaches a considerable size. Malignant tumours tend to invade and obstruct vessels: for example, a bronchogenic carcinoma may invade and obstruct the superior vena cava while the neoplasm is otherwise still "silent." Demonstration of the extent of vascular invasion is of considerable importance (Dotter and Steinberg, 1951[2, 3]) and may influence prognosis and treatment. An example of a non-invasive mediastinal tumour is shown in Fig. 5. The patient was a boy of 12 years of age, without symptoms, in whom a mediastinal shadow was discovered at mass radiography. Fluoroscopy suggested that the mass was not arising from the great vessels, and this was confirmed by angiocardiography. At thoracotomy a circumscribed encapsulated tumour was removed and found on histological examination to be a vascular tumour of cirsoid type. Thus, although angiocardiography showed that it was not an aneurysm of the great vessels, it failed to demonstrate the vascular nature of

the tumour. This case illustrates the limitations, as well as the value, of the method, which will not differentiate between different types of tumours which do not arise directly from the great vessels. Fig. 6 shows the disordered vascular pattern arising from obstruction of the superior vena cava due to a bronchial carcinoma, and Fig. 6*a* illustrates the reduction in the obstruction following radiation therapy.

In the upper mediastinum angiocardiography differentiates between aneurysm of the arch of the aorta and its branches, on the one hand, and tumours, cysts and lymphadenopathy on the other. Fig. 7 is the antero-posterior radiograph of a man of 38 years, without symptoms, and shows a circumscribed homogeneous opacity in the region of the innominate artery. The angiocardiogram (Figs. 7*a* and *b*) demonstrates the integrity of the pulmonary artery and of the aorta and its branches, and shows the shadow to be extravascular.

Below the hilar level, opacification of the cardiac chambers will distinguish between cardiomegaly and pericardial effusion, tumours or cysts. Intracardiac space occupying lesions, such as ball thrombi and myxoma of the left auricle, may be demonstrated (Goldberg *et al.*, 1952).

2. *Peripheral Lung Shadows*

Arteriovenous aneurysm of the lung has already received mention, but angiocardiography has also been used to investigate other peripheral tumours. Dotter and Steinberg have had considerable experience in this field, and consider that the method should always form part of the investigation of any peripheral lung shadows or of carcinoma of the lung. Experience in this country has not been sufficiently extensive to allow of the same conclusion, but there is no doubt that useful information may be obtained, since invasion and obliteration of branches of the pulmonary artery offer some indication of the degree of malignancy.

Dangers of Angiocardiography

Steinberg *et al.* (1950) reported no complications in 1,000 cases of mediastinal and other intrathoracic lesions studied by angiocardiography, and our experience also suggests that the investigation carries a very small risk indeed in patients with normal cardiac and pulmonary function, provided that sensitivity reactions to the contrast medium are excluded. Impairment of renal or hepatic function increases the risk, since the diodone is not rapidly excreted. Obstruction of the superior vena cava may predispose to venous thrombosis, because the contrast medium is very slowly removed.

When patients with severely damaged heart or lungs are considered, the risk is considerably greater, especially in children with severe cyanotic congenital heart disease. A questionnaire by Dotter and Jackson (1950) revealed that the mortality in 6,824 investigations conducted in 182 different hospitals was 0·38 per cent., and that the majority of deaths occurred in infants with cyanotic congenital heart disease.

It is clear, therefore, that in the diagnosis of intrathoracic tumours and shadows angiocardiography is a valuable investigation and that the risks of the procedure are small.

Conclusions

It will be seen that the main value of angiocardiography in intrathoracic disease other than that due to congenital cardiac disorders lies in the differentiation of abnormal conditions of the heart and great vessels from mediastinal space occupying lesions, and in the accurate diagnosis and delineation of both. It is also helpful in localising pulmonary tumours and in assessing their malignancy. Although the method is of rather less value in peripheral pulmonary lesions, it is an essential investigation in pulmonary arteriovenous aneurysms, and may give information of great importance about the pulmonary circulation in other conditions. The risk is extremely small in patients with normal cardio-respiratory function, and in most cases is fully justified by the results. In other cases the risks are greater and must be carefully weighed against the diagnostic importance of the test. Finally, angiocardiography should never be undertaken without full clinical evaluation in every case.

REFERENCES

Angelino. P. F., and Actis-Dato, A. (1952): *Minerva Medica*, **43**, 3.
Baker, C., and Trounce, J. R. (1949): *Brit. Heart J.*, **11**, 109.
Berman, J. K., and Hall, J. E. (1952): *Surg. Gyn. and Obstet.*, **94**, 543.
Blakemore, A. H. (1951): *Ann. Surg.*, **133**, 447.
Crane, P., Lernner, H. L., and Lawrence, E. A. (1949): *Amer. J. Roentgenol.*, **62**, 418.
Dotter, C. T., Steinberg, I., and Temple, H. L. (1949): *Ibid.*, **62**, 355.
Dotter, C. T., and Jackson, F. S. (1950): *Radiol.*, **54**, 527.
Dotter, C. T., and Steinberg, I. (1951)[1]: "Angiocardiography," *Annals of Roentgenol.*, **20**, 123.
Dotter, C. T., and Steinberg, I. (1951)[2]: *Ibid.*, **20**, 238.
Dotter, C. T., and Steinberg, I. (1951)[3]: *Ibid.*, **20**, 242.
Forssmann, W. (1929): *Klin. Wschr.*, **8**, 2085.
Goldberg, H. P., Glenn, F., Dotter, C. T., and Steinberg, I. (1952): *Circulation*, **6**, 762.
Goodwin, J. F., Steiner, R. E., and Lowe, K. G. (1952): *J. Fac. Radiol.*, **4**, 21.
Macgregor, M. (1949): *Brit. J. Radiol.*, **22**, 459.
Poppé, J. K., and de Oliveira, R. (1946): *J. Thoracic Surg.*, **15**, 186.
Ramsey, G., Watson, J. S., Steinhauser, T. B., Thompson, J. Jnr., Dreisinger, F., and Weinberg, S. (1949): *Radiology*, **52**, 184.
Robb, G. P., and Steinberg, I. (1939): *Amer. J. Roentgenol.*, **41**, 1.
Robb, G. P., and Steinberg, I. (1940): *J.A.M.A.*, **114**, 474.
Steinberg, I., Dotter, C. T., Peabody, G., Reader, G., Heimoff, L., and Webster, B. (1949): *Amer. J. Roentgenol.*, **62**, 655.
Steinberg, I., Dotter, C. T., and Andrus, W. de W. (1950): *Surg. Gynæc. and Obstet.* **90**, 45.
Sussman, M. L. (1947): *Amer. J. Roentgenol.*, **58**, 584.
Talbot, T. J., and Silverman, J. J. (1952): *Arch. Intern. Med.*, **90**, 569.
Yater, W. M., Finnegan, J., and Giffin, H. M. (1949): *J.A.M.A.*, **141**, 581.

CHRONIC DISSEMINATED TUBERCULOSIS

A REPORT OF TWO CASES

By Philip M. Ward

From Abergele Sanatorium

The acute miliary dissemination which follows closely upon a tuberculous primary complex is familiar to all, and post-mortem examination of such cases usually reveals an active primary complex, so that the connection between the two is quite clear. Experimentally it has been shown (Pagel, 1939) that after intracutaneous inoculation tubercle bacilli can be recovered from the regional lymph glands within six days, and from the spleen within twenty days, and it is now thought (Court, 1945) that a similar bacillæmia follows soon after the primary phase in most human tuberculosis, from which extrapulmonary lesions may be produced. Clinically this chronic dissemination is usually silent, giving rise to disease outside the lungs often when the primary complex has healed, so that the connection between these two phases is not so apparent.

The following two cases are felt to be of interest in that they show clear clinical evidence of extrapulmonary hæmatogenous foci occurring during, and soon after, the active phase of the primary complex, and quite clearly associated with it. While perhaps not falling accurately into Wallgren's (1948) "Time-table of Tuberculosis," the phases of primary complex, hæmatogenous dissemination and bony lesions, in that order, are well demonstrated.

Case 1

A boy aged 4 months came under clinical observation in February 1950, as a contact to his mother. He was then Mantoux negative, but became positive six months later, when X-ray showed a right hilar shadow and faint mottling throughout both lung fields. He was admitted to hospital, where the gastric lavage was positive, but the diagnosis of miliary tuberculosis was doubtful. Two lumbar punctures were normal. He improved and was transferred to sanatorium later, in February 1951.

His general condition on admission was good, nothing abnormal was found in the chest, and X-ray (Fig. 1) showed faint generalised mottling and hilar enlargement associated with collapse of the anterior segment of the right upper lobe. In series the pre-admission films showed retrogression of the hilar shadow.

A month later a firm swelling appeared anterior to the right shoulder joint, with limitation of abduction, and X-ray showed irregularity of the upper end of the humerus. The other bones were radiologically normal. The swelling rapidly developed into a typical cold abscess from which tubercle bacilli were recovered on two occasions. The blood W.R. and Kahn tests were negative.

The joint was immobilised in plaster and streptomycin (250 mgm.) and P.A.S. (5 gm.) were given daily for three months. X-ray of the chest then showed clearing of the lung fields and further retrogression of the hilar shadow,

(*Received for publication November* 21, 1952.)

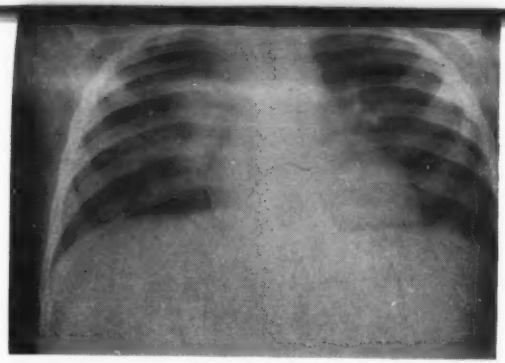

FIG. 1.—Case 1. X-ray of chest 14.2.51, showing faint generalised miliary mottling and right hilar enlargement.

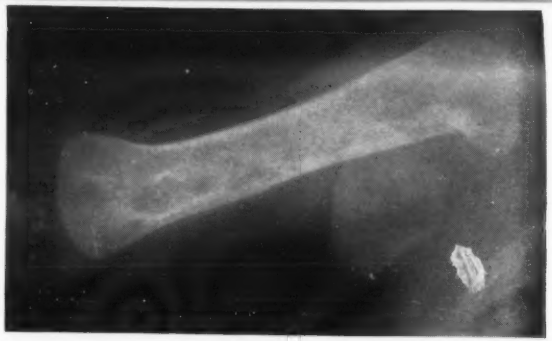

FIG. 2.—Case 1. X-ray of right humerus 3.10.51, showing thickening and cavitation throughout its length.

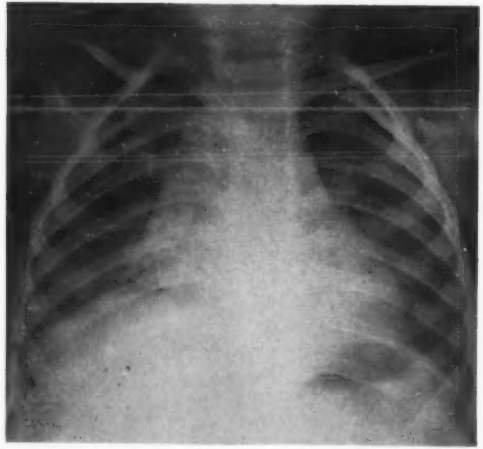

FIG. 3.—Case 1. X-ray of chest 2.1.52, showing clearing of miliary mottling and calcification of primary complex. The upper end of the right humerus is still cystic.

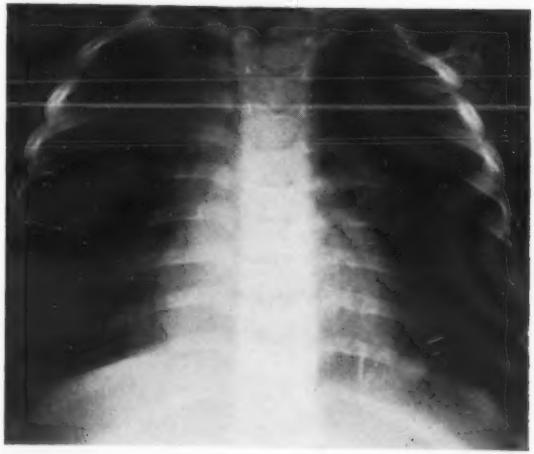

FIG. 4.—Case 2. X-ray of chest 15.6.49, showing left hilar enlargement, a small right pleural effusion, and left basal pleurisy.

To face p. 94

To face p. 95

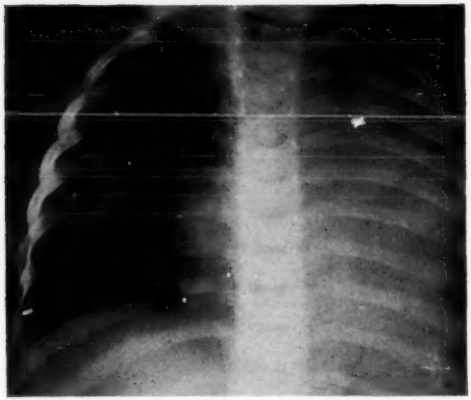

FIG. 5.—Case 2. X-ray of chest 10.10.49, showing massive collapse of the left lung.

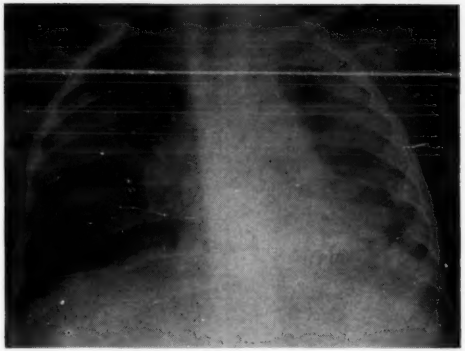

FIG. 6.—Case 2. X-ray of chest 8.3.50, showing clearing of the left lung, but new scattered mottling in both lungs suggesting hæmatogenous spread.

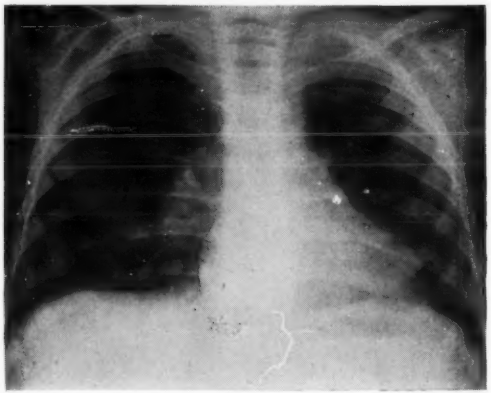

FIG. 7.—Case 2. X-ray of chest 15.11.51, showing clearing of both lung fields.

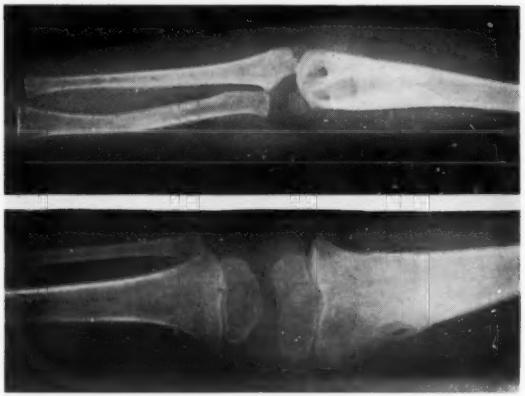

FIG. 8.—Case 2. X-ray of left humerus 19.12.51, showing cystic areas in its lower end.

PLATE XVII

but in the humerus areas of rarefaction were seen for the first time in the upper half of the shaft.

By October 1951 the humerus radiologically showed gross widening and cavitation throughout the whole shaft (Fig. 2) and this thickening could be felt clinically. A further course of streptomycin (½ gm.) and P.A.S. (5 gm) was given daily for three months, with continuation of plaster immobilisation.

In January 1952, the lung fields were practically clear, and large calcified foci were seen in the right upper zone and hilum (Fig. 3). The humerus, though still very cystic, had begun to show new bone formation, and the abscess had healed.

Here the pulmonary hæmatogenous dissemination occurred probably only two or three months after the onset of the primary complex, and did not amount to acute miliary tuberculosis. The bone lesion followed the primary complex by about ten months, and was still active after this had calcified.

The second case is even more striking:

CASE NO. 2

A boy, aged 2, was admitted to hospital in June 1949 with enlargement of the left hilar glands, a small right pleural effusion, and a little left basal pleurisy (Fig. 4). Sterile lymphocytic fluid was aspirated from which no tubercle bacilli were recovered. A gastric lavage was negative, but the Mantoux test was strongly positive. There was no history of contact.

Six weeks later, after a bout of clinical bronchopneumonia, a left pleural effusion developed (that on the right having resolved) the fluid from which was similar to the first. He improved after streptomycin (½ gm. b.d.) had been given for about a month.

By October 15 the X-ray suggested massive collapse of the left lung (Fig. 5) and bronchoscopy revealed an œdematous and completely occluded left main bronchus, and for the first time tubercle bacilli were isolated from the bronchial washings. Streptomycin (¼ gm. b.d.) was given for about a month, with improvement.

Between November 1949 and November 1950 he alternated between general improvement, with increased air entry over the left lung, and deterioration with fever and pneumonic episodes. X-ray in March 1950 showed some clearing of the left lung field, but new scattered mottling especially on the right (Fig. 6). Bronchoscopy, repeated in June 1950, showed a little improvement in the left main bronchus. He was discharged in November 1950, much improved, and with considerable clearing of the left lung, though the lower lobe was still collapsed.

A month later he was re-admitted with bilateral cervical adenitis, glands in axillæ and groins, a palpable liver and spleen, and a fine papular rash, slightly pustular, over the whole face and trunk. The left lower lobe was still collapsed. He improved and was discharged in December 1950

After seven months' clinic observation he was again admitted to hospital with glands on both sides of the neck and in the axilla, and a palpable liver and spleen. Naso-pharyngeal examination, on account of nasal obstruction, revealed thickened lateral pharyngeal walls and palate. Adenoid tissue was absent and antral lavage produced muco-pus on the left only. The sternal marrow was microscopically normal, but axillary gland biopsy showed definite tubercles, and liver biopsy showed many miliary tubercles, some case-

FIG. 8.—Case 2. X-ray of left humerus 19.12.51, showing cystic areas in its lower end.

FIG. 7.—Case 2. X-ray of chest 15.11.51, showing clearing of both lung fields.

ating. In October 1951 subcutaneous abscesses appeared near the left elbow, and three patches of erythema near the left scapula.

He was admitted to sanatorium the same month. His general condition was poor and, in addition to the features already noted, scattered papules were found over the arms and legs, some becoming necrotic, others already healed with brownish discolouration. Ascites was present, with a palpable spleen. The right nostril was discharging. A few bilateral basal râles were present in the chest, and X-ray showed aeration of the collapsed left lower lobe and general clearing of both lung fields (Fig. 7). The soft tissues round the left shoulder and elbow were thickened, and bony thickening could be felt in the left clavicle and in the lower part of the left humerus. X-ray of these parts showed multiple cystic areas in the left scapula, the left clavicle and the lower end of the left humerus (Fig. 8). Further X-rays showed similar cystic areas in the lower end of the right femur, the left acetabulum and the right ischium, but in these places there were no symptoms or signs. The blood W.R. and Kahn tests were negative.

Shortly afterwards the erythematous patches near the scapula developed into typical cold abscesses, and a similar lesion developed in the lower part of the right arm without underlying bony change. At the same time a swelling appeared at the inner canthus of the right eye, and rapidly increased in size with epiphora, broadening of the nose, and reddening of the skin. It was thought to be an ethmoidal cold abscess, and looked as if it was going to break down.

Treatment with streptomycin ($\frac{1}{2}$ gm.) and P.A.S. (6 gm.) daily was started in December 1951, with marked general improvement and retrogression of the nasal lesion. A cold abscess developed at the lower end of the right thigh, associated with the underlying bone lesion (Fig. 9), but has retrogressed without breaking down. The other abscesses have healed. Ascites is no longer present, though the spleen is still palpable, and the cervical glands are hard and appear inactive. It is too early yet to assess the final prognosis, but the position is considerably more hopeful than it was three months ago.

In this case the visceral dissemination began to appear probably six months after the formation of the primary complex, and although the bone lesions were not manifest until nearly two years after the onset, the progress of the disease is clear and continuous. Again the lung dissemination fell short of frank miliary tuberculosis.

The bone lesions in both cases are of special interest, being predominantly in the form of a spreading cystic osteitis. In Case 1, the upper epiphysis, and hence the shoulder joint, was secondarily involved, but in Case 2, although many diaphyses were affected, no joint was involved, the infection tending rather to break through the periosteum and reach the skin to form a discharging abscess. This condition has just been described again by Komins (1952) under the name of multiple pseudo-cystic tuberculosis of bone. He describes radiological appearances in detail (some of which are seen in these two cases), and points out that the nomenclature has been complicated in the past by confusion with the bone lesions of sarcoidosis. His review of the English literature confirms the rarity of the condition, and also its relatively high incidence among the coloured races. He considers that associated congenital syphilis, though present in his own cases, and common in the series he has collected, plays no part in the production of multiple pseudo-cystic tuberculosis

of bone, other than possibly by lowering the general resistance. Certainly the two cases described above show no evidence of syphilis.

Lastly, it is of interest to note that in both these cases benefit has been derived from systemic treatment with P.A.S. and streptomycin, and Case 2 has been helped also by streptomycin powder and P.A.S. jelly to the discharging sinuses.

My sincere thanks are due to Dr. J. B. Morrison, Medical Superintendent of Abergele Sanatorium, for permission to publish these cases, and to Professor F. R. G. Heaf, Professor of Tuberculosis in the University of Wales, for much helpful advice.

ADDENDUM

The account of these two cases was written in March 1952. It is now learned (February 1953) that progress has been maintained, one child being ready for discharge now, and the other being ready shortly.

REFERENCES

COURT, S. D. (1945): "Tuberculosis." U.N.N.R.A.
KOMINS, C. (1952): *Brit. J. Radiol.*, **25**, 1.
PAGEL, W. (1939): "Pulmonary Tuberculosis," Kayne, Pagel, and O'Shaughnessy; Oxf. Med. Pub.
WALLGREN, A. (1948): *Tubercle*, **29**, 245.

CARCINOMATOUS INFILTRATION OF THE WALL OF AN EXTRA-PLEURAL SPACE, WITH SPECIAL REFERENCE TO THE PATHOGENESIS

By P. E. Baldry

From Harefield Hospital, Middlesex

The following case in which a squamous-cell carcinoma infiltrated the wall of an extra-pleural pneumothorax space is reported, as it gave rise to several features of interest and as far as can be ascertained a similar case has not been recorded.

The man had a hæmoptysis in 1937, at the age of 37. A radiograph of his chest revealed the presence of pulmonary tuberculosis, and a year later a right extra-pleural pneumothorax was performed. Refills were discontinued after three years. Periodic radiographs were then taken and showed that the lung never re-expanded and that the space filled up with fluid. The appearances remained constant until March 1951, when a radiograph showed a sudden increase in the amount of fluid causing it to bulge into the underlying lung. As the possibility of rupture into the lung was feared aspirations were performed and clear straw-coloured fluid was removed. It quickly re-accumulated, however, and he was admitted to this hospital on 27.8.51 for further treatment.

On admission he stated that for the past four months he had had pain in the right shoulder radiating down the right arm, with numbness in the fingers. On examination there was no muscle wasting, sensory loss, or vascular disturbances, but the right shoulder was seen to be lower than the left. The pain was made worse by allowing the shoulder to sag and relieved by bracing it. It was considered that this symptom might possibly be part of the "normal first rib syndrome" (Walshe, Jackson, and Wyburn-Mason, 1944), and produced by nipping of the brachial plexus between the clavicle and first rib, the latter structures in this case having become bound together by fibrous tissue developed as a result of the long-standing extra-pleural hydropneumothorax. In an attempt to relieve this pain and to obviate the risk of a broncho-extrapleural fistula it was decided to close the space by a thoracoplasty.

The radiograph taken immediately before operation, however, showed erosion of the first and second right ribs (Fig. 1), and as a result of this an exploratory thoracotomy was performed. At operation a growth was found infiltrating the roof of the extra-pleural space, eroding the posterior ends of the first, second and third ribs, and extending medially into the vertebræ in the region of the 1st dorsal nerve root. Much of the abnormal tissue was removed, together with parts of the upper seven ribs.

The pathological report stated that this material was composed of dense fibrous tissue irregularly infiltrated with trabeculæ of squamous carcinoma. Prickle cells were a special feature, but keratinisation was not very marked.

Bronchoscopy was done at a later date in view of these findings, but no abnormality was seen.

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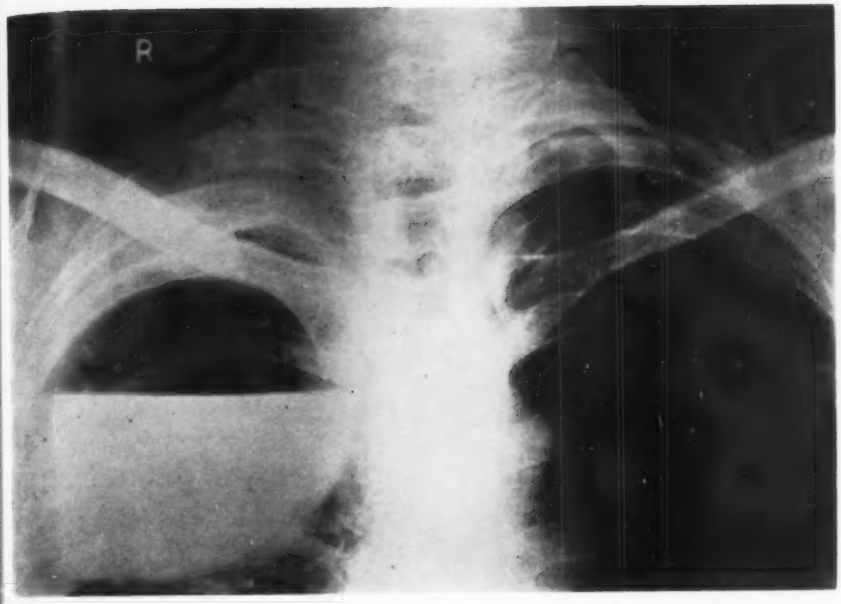

FIG. 1.—Radiograph to show erosion of the posterior ends of the first and second ribs on the right side.

FIG. 2.—Photograph of the right lung to show extensive infiltration of the walls of the extrapleural space by carcinoma. Also a small area of growth at the periphery of the lung.

The post-operative course was associated with increasingly severe pain in the right arm, aggravated by any movement. A right Horner's syndrome developed, also weakness and wasting of the intrinsic muscles of the hand and some sensory loss in the distribution of the 8th cervical and 1st and 2nd dorsal nerve roots.

He was transferred from this hospital to undergo a course of radiotherapy, but this was without benefit and he died six months later.

Extract from the Post-mortem Report

" On the right side there is a thoracotomy scar with drainage channel. The upper seven ribs have been surgically fractured, and this side of the chest is flattened.

The right lung is adherent to the mediastinum and diaphragm and there is a large space (the extra-pleural space) between the lung and chest wall which is lined by growth. In most parts this is only about 0·5 cm. thick, but at the base and apex it is more massive. At the apex it actually extends into the root of the neck, forming a mass about 6 × 4 cms. The lung is everywhere clearly demarcated from this growth except at two points on its lateral surface (Fig. 2). Around this area also there is some old tuberculous scarring with points of calcification. Microscopically the growth is a scirrhous well-differentiated squamous carcinoma. Metastases are present in the liver, left adrenal and small gut."

The Pathogenesis

In view of the unusual features of this tumour it is of interest to speculate as to its origin. There appear to be three possibilities: either it arose from metaplasia of the pleural serosa, or from a peripheral bronchial carcinoma, or had its origin in a skin implant occurring during the course of repeated refills.

Young in 1928 furnished strong evidence that squamous metaplasia of serosal cells may occur, when he produced areas containing transitional and stratified squamous epithelial cells in the pleural cavities of rabbits by injecting a mixture of Sudan III and sodium cholate in olive oil. He states that his reason for employing these agents was because Fischer had previously demonstrated the growth-promoting capacity of " fat-soluble " substances.

A similar change occurring in the serous cells of human subjects has been recorded by Crome (1950). He reported four cases in which peritoneum removed at the time of surgical resections showed microscopic areas of stratified squamous epithelium. He considered that the change had been brought about by metaplasia and concluded that although there was no evidence of malignancy it showed that squamous carcinoma may be of serous origin. He considered that serosal metaplasia is probably brought about by inflammation. In support of this he quoted the case described by Yoshida (1937) of a man aged 25 who had had several thoracotomies for bronchiectasis. At autopsy the pleura was found to be studded with many patches of stratified epithelium. He also quoted a case described by Müller (1928-9) in which squamous metaplasia with well-formed prickles occurred in a chronically inflamed olecranon bursa. In our case there must have been inflammatory changes in the space as it had been full of fluid for many years.

The evidence, however, that epithelial tissue in a serous lining has ever

been the site of malignant change is unconvincing. Willis (1948) has reviewed a large number of reported cases, but is unable to accept any of them as proved, and concludes that most, if not all, were only examples of serosal disease secondary to undiscovered tumours usually in neighbouring viscera or at times in distant organs. In this case although the main mass of growth was in the wall of the extra-pleural space and for the most part clearly demarcated from the lung, there was, in addition, a small area of involvement at the periphery of the latter. This was probably the primary growth arising from bronchial epithelium, but it might have arisen as an extension from malignant change in the adjacent tissues.

The last alternative to be considered is that the growth began in an area of implanted skin. This possibility is, unfortunately, like the other two, open to nothing more than conjecture.

One is therefore forced to the disappointing conclusion that this is yet another case where one is left in doubt as to the origin of a serosal carcinoma, but on balance it is considered that the most likely site of origin was the lung.

My thanks are due to Dr. D. M. Pryce for helpful advice during the preparation of the paper, and for the pathological reports; to Dr. L. E. Houghton and Mr. K. S. Mullard for permission to publish the case.

REFERENCES

Crome, L. (1950): *J. Path. Bact.*, **62**, 61.
Müller, H. (1928): *Z. Krebsforsch.*, **28**, 383.
Walshe, F. M. R., Jackson, H., and Wyburn-Mason, R. (1944): *Brain*, **67**, 141.
Willis, R. A. (1948): "Pathology of Tumours," London, p. 184.
Yoshida, T. (1937): *Arch. Path. Anat.*, **299**, 363.
Young, J. S. (1928): *J. Path. Bact.*, **31**, 265.

THORACIC DUCT FISTULA FOLLOWING THORACOPLASTY

REPORT OF A CASE

By Christopher Cummins

From the Thoracic Surgical Unit, Papworth

Chylothorax is defined as the presence of chyle in the pleural cavity and it invariably occurs from a leak in the chylous system. The leak may be caused by erosion of the duct by new growth, by tuberculosis (McNab and Scarlett, 1932) or other pathological cause. It may also be caused by trauma, as in the case reported below. Injury to the thoracic duct during thoracoplasty is recognised as an occasional complication of the operation, and successful ligation of the cut ends has been instanced (Price Thomas and Cleland, 1942).

Except in those traumatic cases where the pleura was injured at the same time as the duct, the presence of chylothorax may be delayed until some time after the injury, and this interval has been computed (Hoffman *et al.*, 1952) as usually between two and ten days, although an interval as long as six and a half years has been reported (Beatty, 1936). The mechanism is the formation of a retropleural chylous pool which may later rupture into the pleural cavity; rupture did not occur in this instance and thus the following case does not fall strictly into the definition of chylothorax. The course and treatment were however sufficiently similar for it to be discussed among these cases.

Sporadic reports of chylothorax have occurred in the literature; the earliest traumatic case, according to Zesas (1912), being that described by Bartolet in 1633. Everhart and Jacobs (1939) discussed the literature on the subject and Goldman (1945) has presented a very comprehensive review.

The definitive treatment of established chylothorax by ligation of the duct within the chest was first described by Lampson (1948). Since then the efficacy of this method has been confirmed by numerous writers (Meade *et al.*, 1950; Hoffman *et al.*, 1952; Whiteside *et al.*, 1949, and others) despite the statement of Whitcomb and Scoville as recently as 1942, that "there is general agreement that no attempt should be made to re-operate in an effort to repair the duct."

A multiplicity of treatments has been proposed at different times. Among them may be mentioned the following: Repeated thoracenteses, which have been used in the majority of reported cases. Open drainage by posterior mediastinotomy (Brown, 1937). Closed drainage (Effler, 1952). Instillation of various substances (Schnug and Rausohoff, 1943; Matson and Stacy, 1940; Gordon, 1940). Collapse measures such as phrenic crush (Schnug and Rausohoff, 1943; Florer and Ochsner, 1945), pneumoperitoneum, pneumothorax (Dorsey and Morris, 1942; Strauss, 1936) and thoracoplasty. Reintroduction of chyle intravenously has also been used as an adjunct to treatment (Little *et al.*, 1942), sometimes successfully (Bauersfeld, 1937; Smith and

(*Received for publication December* 17, 1952.)

Woliver, 1941) but also with fatal results (Whitcomb and Scoville, 1942; Peet and Campbell, 1943).

The mortality rate of chylothorax from all causes, according to Meade *et al.* (1950), has been computed to be in the region of 50 per cent. and, judging from the cases reported prior to 1946 when the above treatments and others were used, this figure probably errs on the low side. That there is still disagreement on the subject of treatment is evidenced by a recent American paper (Effler, 1952) in which a wholly conservative method of management is advocated. The risks of exploration under a general anæsthetic, the problem of locating the leak, anatomic variations and the possibility of conversion to a bilateral process are all quoted by the writer as justification for the method. A reasonable period of observation and conservative treatment are assuredly necessary in these cases, but with the above mortality rate this cannot be considered the only elective procedure.

Since Lampson's (1948) report, the subject has been adequately reviewed by Baldridge and Lewis (1948); Hodge and Bridges (1948); Hoffman, Ivins and Kern (1952), and many others. It is felt that an additional review is unnecessary. It would appear that most thoracic surgeons of experience have encountered this complication of thoracoplasty (Price Thomas). However, in view of the paucity of literature referring to formal ligation of the duct at a second operation, the following case seems sufficiently interesting to be reported.

Anatomy of the Duct

The thoracic duct arises from the cisterna chyli at approximately the level of the second lumbar vertebra and enters the thorax through the aortic hiatus. It invariably (Van Pernis, 1949) lies between the aorta and the azygos vein. It ascends between the œsophagus and the vertebral bodies and here lies slightly to the right of the midline; opposite the fifth thoracic vertebra it inclines towards the left side and then arches above and behind the great vessels in the neck, entering the angle formed by the left subclavian and left internal jugular veins.

Case Report

The patient, L. R., a married woman of 45, was first discovered to have pulmonary tuberculosis in October 1949 when she attended a Mass Miniature Radiography Unit. Her sputum was positive for tubercle bacilli, but after six months in bed at home she became sputum negative. In April 1950 she entered a sanatorium and in August of that year the only evidence of disease was radiological and consisted of a solid focus at the left apex, confirmed by tomograms. On this basis she was accepted for a left upper lobectomy or a segmental resection. Owing to various factors she was not admitted to the Thoracic Surgical Unit until June 1951; at this time the radiological condition was apparently unchanged and she was still sputum negative. On admission her clinical condition was as follows: A stout heavily-built woman who weighed 14 st. 2 lb. No cyanosis and no clubbing of finger nails. The left side of the chest moved less than the right side, but apart from this she had a normal air entry on both sides, with no adventitious sounds. No abnormality was detected in the cardio-vascular system and the blood pressure was 130/80. The rest of the clinical findings were within normal limits and her hæmoglobin was 110 per cent.

FIG. 1.—Pre-operative film showing apical opacity on left side.

FIG. 2.—Film taken after the first stage of the thoracoplasty showing a large volume of chyle in the extrapleural space.

To face p. 102

On 13.7.51 an apical segmental resection of the left upper lobe was performed by Mr. Kent Harrison, and at the operation no other disease was palpable or visible in the remaining lung tissue on the left side. Apical and basal drainage tubes were inserted before the chest wound was closed and these were removed at twenty-four and forty-eight hours respectively. Her post-operative convalescence was complicated by a massive pleural effusion occurring some ten days after the operation and a vaginal trichomonas infection. However, after aspiration of the effusion and local treatment of the vaginitis she progressed favourably and was discharged to the sanatorium on 27.9.51 feeling very well and having a negative sputum. Histological examination of the excised apical segment confirmed that the lesion, roughly 1 cm. in diameter, was in fact tuberculous process and that the adjacent lung parenchyma showed no active disease. Soon after her return to the sanatorium she developed a contralateral pleural effusion, and as this was increasing she was given streptomycin and P.A.S. for a period of three months. At the end of this period, although her B.S.R. was only 3/200, its was evident radiologically that some cavitation had occurred in the remaining part of the left upper lobe and it was decided to perform a left thoracoplasty. She was readmitted to the Thoracic Surgical Unit, and on 13.5.52, at the first stage of the thoracoplasty, the first, second and third ribs were removed and an apicolysis was performed down to the arch of the aorta, some difficulty being encountered owing to the adherent pleura. She had a normal and completely afebrile convalescence until the eighth post-operative day, when the wound was exposed for the first time for the removal of stitches. It was then apparent that the wound was elevated throughout its length by a long, curved, sausage-shaped tumour which was fluctuant. Aspiration revealed a milky fluid which was confirmed as chyle. A similar fluid was obtained by aspiration of Semb's space anteriorly through the bed of the resected first rib and it was evident that the thoracic duct had been injured during the apicolysis. About 30 oz. of chyle were removed at this first aspiration. The wound edges were slightly moist, and as disruption was a possibility owing to the bulging, the skin sutures were left *in situ* for a further five days. Daily aspirations of the wound region and Semb's space were commenced and the second stage of the operation was postponed. During the succeeding thirteen days some 260 oz. (13 pints) of chyle were removed by aspiration, despite the fact that she was on a fat-free diet for eleven of those days. At the second stage of the operation (three weeks after the first stage) some 2 pints of chyle were evacuated, and when the region of the fistula was mopped dry the leak was immediately apparent at the level of the arch of the aorta. A little dissection revealed a complete tear of the main thoracic duct with chyle dripping from the torn end of the caudal segment at the approximate rate of thirty drops a minute. The duct at this stage was collapsed and not much thicker than a piece of No. 30 linen thread; it was apparent that the rate of flow was increased at each push of the bag controlling respiration. The leaking end of the duct was isolated and ligated with No. 60 linen thread, but a search for the other torn end was unsuccessful, and as no chyle was seen to be escaping from this region it was not further sought for or ligated. Almost immediately after the caudal segment had been ligated it began to increase in diameter and within a few minutes was approximately the diameter of a No. 6 catheter (English).* By this time the first ligature looked somewhat precarious and another was applied. It was then observed that the mediastinal

* The pressure within the duct is normally low, but it has been shown (Drinker and Yoffey, 1941) that it can reach a pressure of 35 cm. of water after ligation.

and other walls of the space limiting the chylous pool were covered with a soft whitish deposit some $\frac{1}{8}$ inch thick; this was not particularly adherent and could be wiped away without difficulty. The thoracoplasty was completed by removing the fourth and fifth ribs, no remobilisation was attempted and the wound was closed in the usual way. Post-operative convalescence was uneventful and a diagnostic aspiration of Semb's space on the day after the operation revealed a blood-stained fluid, later reported to have a fat content of 0·13 per cent. as compared with the pre-operative reading of 4·8 per cent. This small percentage must have been due to residual chyle, because subsequently there was no radiological evidence of increase in the extra-pleural fluid and it became evident that the leak was controlled. The patient was discharged to the sanatorium on 21.6.52 and subsequent progress has been good, all laryngeal swabs since the operation having been negative on smear and culture, and at the time of writing this report she was up for six hours a day.

Discussion

The local effect of chyle on the pleura was noted by Meade *et al.* (1950), but there are only scanty references in the literature to the local effect of chyle on other tissues. Longmore (1952) states that " chyle is non-irritant to connective tissues, since no sign of fibrous proliferation was found in neck tissues." It was unfortunate that in the case reported in this article none of the deposit was saved for histological examination; however, whether or not chyle is irritant to connective tissue it is apparent that part of it can deposit easily on tissues other than pleura.

The effects of a fat-free diet have been considered by a few writers, among whom Little *et al.* (1942) showed convincingly that with this régime the daily volume of chyle was decidedly reduced from 1,200 c.c. to 689 c.c. In their case the total lipid content also showed a marked decrease, and on the whole it would seem rational to use such a diet as an adjunct to the treatment of these cases. The daily output of chyle, which was approximately a pint a day in the case reported here, was within the limits of daily excretion reported by Crandell *et al.* (1943). It seems worth recording that a decrease in the daily volume of chyle aspirated is not necessarily an indication of impending closure of the fistula, as larger volumes may subsequently be removed, *vide* the case reported by Lampson (1948).

As some 60-70 per cent. of ingested fat is conveyed to the bloodstream via the thoracic duct (Baldridge and Lewis, 1948), commencing inanition in cases with a chylous fistula make it undoubtedly important to choose the optimum time for surgical intervention. In all fatal cases of chylothorax where death does not occur from asphyxia it is said to be due to inanition consequent upon progressive loss of fluid, protein and fat. Operation to be successful must obviously be done before the patient reaches this state. Meade *et al.* (1950) advise waiting no longer than two weeks before operation in cases with chylothorax, their main reason apparently being that they believe a longer period of waiting may result in encapsulation of the lung which may require decortication before it can re-expand fully. In the case reported here, the extra-pleural chylous pool had been present for three weeks and had not burst through into the pleural cavity. If it had done so and the amount of chylous deposit on the pleura had been the same as that found on the extra-pleural tissues, then

decortication might well have been required; it would, however, have been easily accomplished at this stage. The patient, incidentally, did not show any sign of inanition at the time of the last operation, probably because she was very fat.

Some cases have recovered after a fistula of five months' duration (Matson and Stacy, 1940; Hoffman *et al.*, 1952), but obviously in no case reported to have recovered after conservative treatment can it be certain that the duct was completely divided. On the contrary, these cases probably had a leak from a collateral branch. The problem of infection of the intra—or extra—chylous pool does not often occur. This is said to be due to the bacteriostatic property of chyle (Lampson, 1948). On the other hand, the pressure of a large volume of fluid adjacent to the lung may predispose towards atelectasis and subsequent pneumonia. The latter was a frequent cause of death in the earlier reported cases.

On the whole it would appear that shorter rather than a longer period of conservative treatment in the form of aspiration and diet is preferable in cases of chylous fistula. While no hard-and-fast rules can be laid down, the production of half a pint or more a day over a period of three weeks would seem to indicate that the time has come to consider surgical intervention. In our case the second stage of the thoracoplasty provided the opportunity for investigation of the torn duct. At operation the leak must first be located. Thereafter the possible procedures are anastomosis, tamponnade or ligation.

Anastomosis to a vein has been successfully performed (Hodge and Bridges, 1948) and anastomosis of the cut ends of the duct or repair of the wall is feasible, but these methods may be technically impossible as well as being unnecessarily complicated. Tamponnade of the region of the fistula may be required if the cut ends of the duct cannot be located (Schumacker and Moore, 1951), but as the thoracic duct has innumerable collateral communications with the lumbar intercostal and azygos veins (Lee, 1922) it has been suggested (Lampson, 1948) that the main duct should always be ligated in addition to any local treatment of the tributary. The third available procedure is ligation and this is undoubtedly the simplest, and in our case was a most effective, means of dealing with the chylous fistula.

Summary

1. A chylous fistula following thoracoplasty and its subsequent successful treatment by thoracic duct ligation is described.

2. The treatment of chylous fistula is reviewed.

My thanks are due to Mr. G. Kent Harrison, until recently the Consulting Thoracic Surgeon to this unit, who entrusted me with the operative treatment of this case; to his successor, Mr. C. Parish, for helpful suggestions; to Dr. D. B. Cruickshank for the pathological reports; and to Mr. E. W. Groves, Chief Radiographer, for the X-ray reproductions.

REFERENCES

Baldridge, R. R., and Lewis, R. V. (1948): *Ann. Surg.*, **128**, 1056.
Bauersfeld, E. H. (1937): *J.A.M.A.*, **109**, 16.
Beatty, O. A. (1936): *J. Thorac. Surg.*, **6**, 221.
Brown, A. L. (1937): *Arch. Surg.*, **34**, 120.
Crandell, L. A., Barber, S. B., and Graham, D. G. (1943): *Gastroenterology*, **1**, 1040.

DORSEY, J. F., and MORRIS, G. E. (1942): *J.A.M.A.*, **119,** 337.
DRINKER, C. K., and YOFFEY, J. M. (1941): "Lymphatics, Lymph and Lymphoid Tissue," Cambridge, Mass., Harvard University Press.
EFFLER, D. B. (1952): *Clevland Clin. Q.*, **19,** 1.
EVERHART, J. K., and JACOBS, A. H. (1939): *J. Pediat.*, **15,** 558.
FLORER, R., and OCHSNER, A. (1945): *Surgery*, **17,** 622.
GOLDMAN, A. (1945): *Med. Clin. North America*, **29,** 502.
GORDON, J. (1940): *Ann. Int. Med.*, **13,** 1998.
HARRISON, E. (1916): *Brit. J. Surg.*, **4,** 304.
HODGE, G. B., and BRIDGES, HUNTER (1948): *Surgery*, **24,** 805.
HOFFMAN, E., IVINS, J. L., and KERN, H. M. (1952): *Amer. Med. Ass. Arch. Surg.*, **64,** 253.
LAMPSON, R. S. (1948): *J. Thorac. Surg.*, **17,** 778.
LEE, F. C. (1922): "The Establishment of Collateral Circulation following Ligation of the Thoracic Duct," Bull. Johns Hopkins Hospital, **33,** 21.
LITTLE, J. M., HARRISON, C., and BLALOCK, A. (1942): *Surgery*, **11,** 392.
LONGMORE, A. J. (1952): *Canad. Med Ass. J.*, **66,** 377.
MATSON, R. C., and STACY, J. W. (1940): *Dis. Chest.*, **6,** 332.
MCNAB, D. S., and SCARLETT, E. P. (1932): *Canad. Med. Ass. J.*, **27,** 29
MEADE, R. H., JR., HEAD, J. R., and MOEN, C. W. (1950): *J. Thorac. Surg.*, **19,** 709.
PEET, M. M., and CAMPBELL, K. N. (1943): *Univ. Hosp. Bull.*, **9,** 2.
PRICE THOMAS, CLEMENT. Personal Communication.
PRICE THOMAS, C., and CLELAND, W. P. (1942): *Brit. J. Tuberc. and Dis. Chest*, **36,** 129.
SCHNUG, E., and RAUSOHOFF, J. (1943): *Surgery*, **14,** 278.
SCHUMACKER, H. B., and MOORE, T. C. (1951): *Surg. Gyn. Obst.*, **93,** 46.
SMITH, D. D., and WOLIVER, E. (1941): *Arch. Surg.*, **43,** 627.
STRAUSS, A. (1936): *J. Thorac. Surg.*, **5,** 539.
VAN PERNIS, P. A. (1949): *Surgery*, **26,** 806.
WHITCOMB, B. B., and Scoville, W. B. (1942): *Arch. Surg.*, **45,** 747.
WHITESIDE, W. C., STEWART, W. D., and CUTHBERTSON, A. N. (1949): *Canad. Med. Ass. J.*, **61,** 374.
ZESAS, D. G. (1912): "Die Nicht Operative Entstanden Verletzungen des Ductus Thoracicus," *Deutsche Ztschr. f. Chir.*, **115,** 49.

POLYCYTHÆMIA VERA IN CHRONIC PULMONARY TUBERCULOSIS

By Philip Ellman and A. C. Fairburn
From Plaistow Hospital Chest Unit, London

A compensatory erythrocytosis frequently develops when the oxygen-saturation of arterial blood is defective, as in chronic cyanotic pulmonary disease, but the rare condition of polycythæmia vera has, since Vaquez' original description in 1892, also been recognised as a complication of tuberculosis.

Polycythæmia vera is distinguished from a compensatory erythrocytosis by the presence of an increase of the myeloid constituents of the blood and its platelet content, with enlargement of the spleen. If, however, the red cell count is not raised to the classical levels of 7-9 million/c.mm. owing to an additional factor such as bleeding or chronic infection, the diagnosis may be obscured until a complete hæmatological examination is made.

The following case illustrates the coincidence of chronic pulmonary tuberculosis and polycythæmia vera.

Case Report

W. J., then aged 49, was admitted to hospital on 1.9.45 for investigation of headaches and abdominal pains. He was found to have a pyrexia of 99-103° F., to be clinically emphysematous, and to have an enlarged liver (1 inch) and spleen (2 inches) below the subcostal margin. His blood-count was:

Hb.	...	...	78%.
R.B.C.'s	...	...	3·84 million c.mm.
W.B.C.'s	...	...	32,000 c.mm. (Polymorphs, 85%; Lymphos., 13%; Monos., 2%.)

and chest X-ray showed left apical scarring.

After two weeks' bed-rest the fever subsided, his spleen became impalpable and he was transferred to a sanatorium, where the chest condition was judged to be inactive. Thence he continued at home, under the supervision of the Chest Clinic.

On May 20, 1952, he was admitted to the Plaistow Hospital Chest Unit under the care of Dr. Philip Ellman, for investigation of bilateral but predominantly left-sided upper abdominal aching pain, which for six months had appeared immediately after food, and was unrelieved by alkalis or antispasmodics. For three months the pain had been almost continuous, accompanied by a frequent, painful diarrhœa. Appetite was generally poor, he never vomited, and micturition was normal.

Examination showed a thin, tense man of 56, running an intermittent evening temperature of 99° F. He was not cyanosed and had no finger-clubbing, but his face was usually of a "high colour." Examination of the chest revealed hyper-resonance over both lung-fields, generalised harsh breath-sounds, and variable apical inspiratory râles. The Vital Capacity was 2,800 c.c.

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His tongue was glazed, sore and centrally cracked, and the pharynx was very injected. Palpation of the abdomen revealed tender loins and left costal margin, a firm liver edge (1 inch) and a moderately tender descending colon, but the spleen was not palpable. Rectal examination caused much local pain and spasm but was otherwise normal.

No abnormality was found in the cardiovascular and central nervous systems.

INVESTIGATIONS

Sputum: A.F.B. positive.
E.S.R.: 4 mm./hr. (Westergren).
Chest X-ray and tomogram: Bilateral chronic fibrotic lesions at apices, with secondary bronchiectasis.
Throat-swab: A few non-hæmolytic streptococci; no moulds.
Hæmoglobin: 120% (17·9 gm. %).
W.B.C.'s: 22,900/c.mm. Polymorphs, 79%. Lymphocytes, 18%. Eosinophils, 2%. Monocytes, 1%.
Stool and mid-stream urine: Normal.
Sigmoidoscopy, barium enema, barium meal, radiology of the spine and I.V.P.: Normal.

Pain, his chief complaint, persisted and was associated with a great deal of worry, being apparently relieved at times by placebos. The moderate pyrexia continued, as did the leucocytosis, which varied in weekly counts from 32,000-40,000 W.B.C.'s/c.mm., so that a careful search for deep-seated suppuration was made. The stomatitis and proctitis did not respond to oral vitamins.

Two months after admission the spleen became palpable, and slowly enlarged to about 2 inches below the costal margin. At that time his blood-picture was as follows:

Hb.	...	...	120% (17·8 gm. %).
R.B.C.'s	...	...	5,950,000/c.mm. M.C.H.C., 32%. M.C.V., 93 $c\mu$. P.C.V., 55%.
W.B.C.'s	...	...	38,200/c.mm. (Polymorphs, 84%.)
Platelets	...	...	1·68 million/c.mm. (hæmatocrit volume, 6%).

This and subsequent blood counts showed a consistent erythrocytosis of normocytic type, never exceeding 6 million red cells, with variably raised levels of leucocytes and platelets. The possibility of leukæmia was excluded by sternal puncture, which revealed a normally cellular marrow with excess of megakaryocytes, and this, together with enlargement of the spleen, confirmed the diagnosis of polycythæmia vera.

On being reassured that the diagnosis of a harmless blood abnormality was established the patient became noticeably more cheerful, lost most of his pain, and was discharged home to continue a sanatorium régime.

Discussion

The origin of the stimulus to the marrow, which causes the over-production of blood-elements found in polycythæmia vera, is not known, but attempts have been made to relate it to coexistent tuberculosis.

The earlier cases, described mainly by French writers, were those of extensive pulmonary tuberculosis with generalised systemic or miliary spread

throughout the body. Under these conditions, involvement of the spleen was not infrequently found at post-mortem, and it was concluded that some splenic factor was produced as a result of the infection of the organ.

Conversely it has been suggested (Engelbroth-Holm, 1939) that spread of the infection to the spleen occurred when it had been weakened by coincidental polycythæmia vera.

Fitzpatrick and Schwartz (1949), in a review of the literature, analyse thirty cases of widespread or miliary tuberculosis with extensive involvement of the spleen and erythrocyte counts of over 5 million, of whom all but seven had a significant leucocytosis. No explanation for the coexistence of the two conditions emerged in this survey.

If splenic tuberculosis can directly cause polycythæmia vera, a cure following splenectomy might be expected. The effect of splenectomy on the blood-picture in four cases of so-called primary tuberculosis of the spleen with erythrocytosis, quoted by Fitzpatrick and Schwartz, was inconclusive.

More recently, Guild and Robson (1950) report a case with widespread pulmonary tuberculosis and polycythæmia vera in which the blood disease did not improve during a careful hæmatological follow-up, after removal of a tuberculous spleen. These findings are consistent with the coincidental occurrence of the two diseases.

In our patient, splenic tuberculosis cannot with complete certainty be ruled out, for this is difficult in the living patient without recourse to laparotomy, but the absence of gross splenic enlargement and of widely disseminated tuberculosis makes it extremely improbable. He does, however, demonstrate the mild and fluctuating nature of polycythæmia vera before the mechanical effects of a gross plethora and increased blood viscosity become evident.

The mild erythrocytosis was overshadowed by a gross granulocytosis and increase in platelets, and this had probably been so for seven years. In the absence of chronic bleeding this may be explained in a patient with polycythæmia vera by the inhibitory effect of a chronic infection on erythrocyte production, in the light of work by Wintrobe, Cartwright, and others (1946). They have shown that in the intractable anæmia associated with chronic infection there is a consistently low plasma iron level, that this is not remedied by flooding the plasma with intravenous iron, and they have confirmed that chronic infection in humans may result in diversion of 46 to 88 per cent. of absorbed iron to the spleen and liver.

We believe, in the absence of positive evidence, that either disease causes or aggravates the other ; the occurrence, in the case we have described, of pulmonary tuberculosis and polycythæmia vera was coincidental, and that modification of the blood-picture by the above mechanism was the result.

Summary

A case of polycythæmia vera complicating chronic pulmonary tuberculosis is described.

It is suggested that the two conditions were coincidental and that the lack of gross changes in the red cell series in this case was due to the presence of chronic infection.

We wish to thank Dr. J. V. Dacie of the Department of Hæmatology of the Post-graduate Medical School of London for helpful advice and criticism, and Dr. R. A. Melick for help with the literature.

REFERENCES

ENGELBROTH-HOLM, J. (1938): *Amer. J. Med. Sci.*, **195,** 32.
FITZPATRICK, W. J., and SCHWARTZ, S. O. (1949): *Amer. Rev. Tuberc.*, **60,** 660.
GUILD, A. A., and ROBSON, H. N. (1950): *Ed. in Med. J.*, **57,** 145.
CARTWRIGHT, G. E., LAURITSEN, M. A., JONES, P. J., MERRILL, I. M., and WINTROBE, M. M. (1946): *J. Clin. Invest.*, **25,** 65.
GREENBERG, G. R., ASHENBRUCKER, H., LAURITSEN, M. A., and WINTROBE, M. M. (1947): *J. Clin. Invest.*, **26,** 114.

REVIEWS OF BOOKS

What Everyone Ought to know about Tuberculosis. By M. SANTOSHAM. Madras Crystal Publishing House. 1952. Pp. 239. Illustrated. Price Rs. 6-8-0.

In his preface Dr. Santosham states: " I consider it my duty to write this book, through which and through its translations into the various Indian languages I aim to eradicate ignorance and infuse the right knowledge concerning this disease."

The work is intended for Indian audiences and is an attempt to spread information regarding the appalling problem of tuberculosis in India. It aims at giving accurate information to patients and their relatives, and it has been written, Dr. Santosham adds, so as to be comprehensive and interesting enough to the reading public. " The book is not intended to be an exhaustive guide to a medical practitioner, yet it can be used with great benefit by many rural practitioners who may not be in touch with everyday developments in the field of tuberculosis."

Finally, the author hopes that it will be an invaluable aid to many who are not qualified doctors, but who " from experience in the treatment of patients and in hospital routines may be called upon to give advice from time to time." It is thus ambitious in its scope and is designed for many classes each requiring a different method of approach.

It would be easy to criticise this book destructively—to point out that diagrams of thoracoplasties and purely medical details are more likely to depress than to encourage patients; that the reading public is unlikely to understand much that it contains; that what suits a social worker may not help the harassed doctor; and so on—but the obvious sincerity of the author's approach to his task, the sympathy and understanding with which he writes, and his wide knowledge of the disease and its problems, gain one's sympathy and respect. If he has failed in some respects in his self-imposed and difficult task, he has succeeded in many others, and he has produced a compact, simply written treatise on tuberculosis which will appeal to the several classes for which he writes.

There are some misspellings of technical terms and proper names, and Calmette and Guérin (whose name is among those misspelt) were distinguished French, not Danish, scientists. Many with wide experience of tuberculosis will not share the author's optimistic views on the curability of tuberculosis, particularly as it is seen, and as he describes it, among Indians; but the confidence of the physician in his power to heal is an asset the value of which none will gainsay.

CHARLES CAMERON.

Diseases of the Chest. Edited by Sir GEOFFREY MARSHALL, K.C.V.O., C.B.E., and KENNETH M. A. PERRY. London: Butterworth and Co. (Publishers) Ltd. 1952. In 2 volumes: Vol. I, pp. 456, 158 figures; Vol. II, pp. 413, 192 figures. Price £7 7s.

These two comprehensive volumes on diseases of the chest, edited by Sir Geoffrey Marshall and Dr. Kenneth Perry, illustrate in the writings of thirty-one expert contributors the high standard attained by British medicine with special reference to progress in intra-thoracic disease.

Both volumes are beautifully illustrated by numerous X-ray reproductions, although these are somewhat unevenly distributed. For example, the chapter on Empyema is illustrated with nineteen radiographs, while that on Emphysema has a single one. Again, if Pulmonary Schistosomiasis merits a radiograph, then surely Polyarteritis Nodosa is at least worthy of the same distinction.

The text does in the main summarise current knowledge in this wide field. In Volume I there is an authoritative chapter on the normal broncho-pulmonary anatomy, profusely illustrated by line diagrams, casts of the bronchial tree and bronchograms, and the more common broncho-pulmonary abnormalities are not forgotten. There is also a most useful article on the applied physiology of respiration. A comprehensive chapter is devoted to the " pneumonias," and the chapter on lung abscess is excellent.

The late Dr. Roodhouse Gloyne introduces the subject of Pulmonary Tuberculosis, with a valuable chapter on Epidemiology and Immunology. Further chapters on diagnosis, pathology and treatment of pulmonary tuberculosis receive due recognition from authoritative sources, but it is unfortunate that the machinery for the prevention of tuberculosis should be given scant attention.

In the second volume chapters on the place of anæsthesia and physiotherapy in chest disease are novel and welcome. The contribution these subjects have made to progress in this sphere is thus duly acknowledged. There are also some valuable articles, among others, on pleural effusions, asthma, sarcoidosis, the reticuloses, honeycomb lungs, intra-thoracic tumours and cysts, and hydatid disease, written by experts on these subjects.

Inevitably where there are multiple contributors some of the chapters are uneven, and some degree of disjointedness is, it would seem, unavoidable.

The publishers refer to " this comprehensive textbook," but the editors make no such claim, and therefore disarm criticism when they say in their preface " an attempt has been made to render the volumes reasonably comprehensive."

One cannot help, however, regretting the absence of an introductory chapter on " The Modern Approach to Diseases of the Chest," with, for example, special reference to history taking, symptomatology, physical examination, the significance of the presence or absence of physical signs, and none could have done this better than the senior editor, from whose pen every reader would undoubtedly have welcomed a contribution.

The omission of a chapter on the development of chest radiology and its part in the growth of our knowledge of chest disease seems unfortunate.

One may hope that in a subsequent edition a contribution on these subjects, and one on the prevention of chest disease, will be included.

These criticisms apart, the two volumes with their comprehensive bibliographies at the end of each chapter do credit to the contribution of British workers to the literature on diseases of the chest, and they will certainly have a very wide appeal.

PHILIP ELLMAN.

The National Health Service in Great Britain. An Historical and Descriptive Study. By JAMES STIRLING ROSS. London: Geoffrey Cumberlege, Oxford University Press. Pp. 398. Price 30s.

The National Health Service was established in 1948. It is a tender plant which requires much care before it can attain its full growth. Perhaps the care has been a little too intensive; there has been a tendency to pull up the

plant to see how it is growing instead of allowing sufficient time for it to obtain firm roots. Mr. Ross appreciates these difficulties, but nevertheless he has written an interesting study of the genesis and administration of this revolutionary service.

Mr. Ross writes as an administrator, but he has consulted medical authorities and shows a fair appreciation of the medical issues involved. Many would have preferred to see so great a change introduced by successive stages. The nuclei of a comprehensive medical service were already present in the Insurance Medical Service, the Public Assistance Medical Service, the Health Services and Hospitals of the local authorities, the specialist provision made by municipal and voluntary agencies and the planning of the Emergency Medical Services. A little co-ordination and development might have welded these services into a comprehensive health service without a great deal of extra expenditure. Parliament, however, decided to aim at perfection, and began doing so even in the middle of a war when our national existence was at stake—a striking testimony to the foresight and imperturbability of the British nation. There was also the important consideration that modern medical treatment has grown so specialised and expensive that to make it available for all classes of of the community a State service was necessary. The expenditure on the service now amounts to four hundred millions a year. Whether the country can continue to shoulder this huge financial burden depends largely upon national industry and the continuation of a profitable export trade. Facts have to be faced, and the author faces them in the financial sections of his book.

As regards tuberculosis, in the course of thirty years before the last war, under the auspices first of the Local Government Board and afterwards of the Ministry of Health, an organisation was established under the major local authorities, which closely integrated the prevention and treatment of the disease, lowered its mortality and diminished the opportunities for infection. This unity has been broken by the National Health Service, which has placed institutional treatment under the Regional Hospital Boards, leaving preventive measures to the Public Health Authorities. Mr. Ross considers that in the administration of tuberculosis, as in mental health—and one might add in infectious diseases—further improvements and co-ordination are required. The book, as a whole, is a store-house of information on the subject of a great experiment, the history of which is still in the making.

ARTHUR S. MACNALTY.

Tuberculose Pulmonaire. Par M. BARIÉTY, A. DUFOURT, P. GALY, E. HAUTEFEUILLE, J. LE MELLETIER, J. LEROUX-ROBERT, J. P. NICO, A. MEYER, A. RAVINA. "Traité dé Medecine." Publié sous la direction de MM. Pr. A. Lemierre, Pr. Ch. Lenormant, Ph. Pagniez, Pr. P. Savy, Pr. N. Fiessinger, Pr. L. De Gennes, A. Ravina. Sécretaires Gêneraux: A. Ravina et J. Patel. Tome VI. Paris: Masson et Cie. 1952.

This is the sixth volume of a series which is designed to cover the whole field of medicine. It is concerned with pulmonary tuberculosis, and in the course of 558 pages it succeeds in covering the ground in great detail.

There is a certain amount of repetition, for the third volume of the series treats of tuberculosis among other diseases, and it might have been an advantage if the two sections dealing with tuberculosis could have been amalgamated.

The first sections, on the primary infection, epituberculosis and miliary tuberculosis, are in a sense introductory to the main theme of the book, which is largely concerned with adult tuberculous disease, but these sections are so

well written and so comprehensive that they set a high standard for the remainder.

The clinical and pathological aspects are exhaustively considered and the subject matter is well presented.

The section on treatment is particularly good. It deals with every aspect of physical, drug and collapse treatment, and it presents a singularly well-balanced picture of the most modern views on the management of tuberculous diseases. Artificial pneumothorax should be kept up for three years on the average, and this is the latest view which has been expressed in this country. The indications for thoracoplasty are very clearly set out and they are very sensible, although not all in this country appear to think upon the same lines. The author states that, in practice, thoracoplasty should not be carried out unless there is cavitation in the lung. He does not appear to recognise the " prophylactic " thoracoplasty, which appears to be rather popular in some circles in this country. This is not a demerit.

The book is well printed on excellent paper and the illustrations are particularly good. One can see at a glance the point which the writer wishes to illustrate.

Perhaps the references might be more fully presented. One has the impression that the major work on tuberculosis has been done on the Continent, particularly in France, and not sufficient credit is given to the efforts of those in Great Britain and the United States.

JAMES MAXWELL.

The Principles and Practice of Medicine. By L. S. P. DAVIDSON. E. and S. Livingstone, Ltd. 1952. Pp. 919. Price 32s. 6d.

The appearance of a new book upon a stereotyped subject must excite enquiry as to what it has to offer to supply a recognised need. There are already several textbooks in the form of symposia; for such is the complexity of modern medicine that no one man can possibly acquire a specialised knowledge of all its branches. The passing of the general physician, however much regretted, has to be accepted. The present work has a distinct advantage over similar symposia in that the contributors are not drawn from medical schools in various parts of the country, but are all members of the staff of the Department of Medicine of Edinburgh University and its associated clinical units. As a consequence of the close co-operation existing between them, there is a nearer approach than usual to the balanced style that characterises the work of a single author whilst retaining the depth of knowledge and experience which only a team can supply.

Professor Davidson has maintained a general control and close scrutiny throughout every section, an influence which, as one would expect, is most evident in certain subjects with which Professor Davidson himself and the tradition of the Edinburgh school are particularly identified.

For the most part, rare diseases are omitted. References are naturally not expected and synonyms are avoided to such an extent that probably less than fifty are utilised, and these so incorporated into the language of medicine that they could be replaced only by a clumsy periphrasis.

It is easy enough to criticise the absence of certain features and the rather arbitrary means of approach. For example, Infectious Diseases as such are excluded, but in order to deal with the Typhoid Fevers they are placed under Diseases of the Digestive System.

The work is intended for students and doctors. Whilst it will undeniably

be of service for reference to the qualified practitioner, it is really more appropriate for the student intent on his final examination desiring essential factual presentation. It is, however, more than a " cram-book ": sufficient detail is introduced to make the material agreeable to the palate and suitable for digestion and assimilation.

ADOLPHE ABRAHAMS.

Aids to Tuberculosis Nursing. By L. E. HOUGHTON and T. HOLMES SELLORS. London: Baillière, Tindall and Cox. Fourth Edition. Pp. xvi+307; figs. 63 and 18 plates. Price 6s.

The fourth edition of this complete " Textbook for the Nurse " in the popular Nurses' Aids Series is certain to be as well received as were the three previous editions.

Like its predecessor, which it amplifies and develops, the present (fourth, January 1953) edition is eminently readable, and contains four appendices with the supplement of excellently reproduced X-ray photographs, each with an explanatory diagram.

The introduction to the present volume is an admirable exposition of the development and present form of the tuberculosis service, and this subject is still further approached with boldness and tact at the end of the book in Chaper XXIII (p. 257), in a footnote to which the authors' indebtness to Dr. Brian Thompson is gracefully acknowledged.

The same diplomatic approach is notable in the section on B.C.G., p. 12, and indeed it is the wisdom, of which the above are but two examples, that throughout the book makes it such a pleasure to read, while in no way obscuring the mine of information so readily available and well indexed.

Throughout the book occasional reference is made to the psychological relationship of patient and nurse, notably on p. 51 under " Anxiety "; on p. 113, " Occupational Therapy "; and on p. 132 under " Nurse and Patient " in the chapter on Prevention. The points made are not laboured, but nothing is lost by gentle reiteration, and here again the student nurse cannot fail to benefit by this wise insistence.

As the reader approaches the last chapter he may have forgotten that he is reading a textbook intended to prepare candidates for examination, but the four appendices and supplement recall this aspect.

In Appendix IV (Special Apparatus used in Collapse Therapy), p. 281, excellent diagrams of Artificial Pneumothorax Needles are clearly labelled, but in the following three pages this laudable clarity flags, and from Fig. 60 onwards the instruments are unlabelled, though referred to on p. 177.

Admittedly most surgeons employ their own code when requesting or signalling for the instrument required, but in practical examination one has seen individual instruments laid out, and for this reason alone it is perhaps a pity that the authors flagged in this minor way at the very last fence.

L. B. STOTT.

BOOKS RECEIVED

The following books have been received and reviews of some of them will appear in subsequent issues.

Thoracic Surgical Management. By J. R. Belcher, M.S., F.R.C.S., and I. W. B. Grant, M.D., M.R.C.P., with Foreword by Sir Clement Price Thomas. London: Baillière, Tindall and Cox, Ltd. First Edition. Pp. xii+196 with 65 illustrations. Price 16s.

Aids to Tuberculosis Nursing. By L. E. Houghton, M.A., M.D., and T. Holmes Sellors, D.M., M.Ch., F.R.C.S. London: Baillière, Tindall and Cox, Ltd. Fourth Edition. Pp. xii+308, with 18 plates and 63 illustrations. Price 6s.

The White Plague. By René and Jean Dubos. Victor Gollancz, Ltd. Pp. 277. Price 15s.

Tuberculosis in the Commonwealth. By N.A.P.T. Transactions of the Third Commonwealth Health and Tuberculosis Conference, July 1952. Pp. 441. Price 21s.

Famine Disease in German Concentration Camps—Complications and Sequels. With special reference to Tuberculosis, Mental Disorders and Social Consequences. By Per Helweg-Larsen, Henrik Hoffmeyer, Jorgen Kieler, Eigil Hess Thaysen, Jorn Hess Thaysen, Paul Thygesen, Munke Hertel Wulff. Copenhagen: Ejnar Munksgaard. 1952. Dan. kr. 35.00.

Traitement de la Tuberculose par l'acide para-aminosalicylique P.A.S. Direction to Publishers: Jean Paraf and Jean Fouquet. Publishers: J. Paraf, J. Fouquet, P. Zivy, J. Desbordes, A. Abaza, J. Bory and Fournier, E. Peretz, Madeleine Paraf and L. Levy. Price 3,200 francs. Pp. 404 and 29 figures.

Die Behandlung der Knochen- und Gelenktuberkulose. Dozent Dr., ed. Heinz May. Stuttgart: Ferdinand Enke Verlag. 101 illustrations. Pp. 221. DM 30.

The Australasian Annals of Medicine, November 1952. Vol. 1, No. 2, pp. 93-197. Sydney: Australasian Medical Publishing Co. Ltd.

Ergebnisse der Gesamten Tuberkulose Forschung 1953. Band XI H. Beitzke, St. Engel, L. Heilmeyer, J. Hein. Stuttgart: George Thieme Verlag, O.

Tuberculose e Doencas do Aparelho Respitatorio. By Jose Silveria. Vol. 1. Bahai, Brazil: Livraria Progresso Editora. 1952. Pp. 456, illustrated.

B.C.G. Vaccination. Studies by the WHO Tuberculosis Research Office, Copenhagen. World Health Organisation Monograph Series. Pp. 307. Price 15s.

Tuberkuloza: Colloquium Streptomycinicum, 5-6. Izdaje Savez Lekarskih Drustava Fnrj. Uzi Redakcioni Odbor: Prof. Dr. R. Neubauer, Sezana; Dr. M. Grujic, Dr. J. Studic, Prof. S. V. Stojanovic, Beograd. Siri Redakcioni Odbor: Dr. St. Ibler, Zagreb; Prof. Dr. Sp. Janovic, Sarajevo; Dr. T. Furlan, Golnik; Prof. Dr. G. Muratovski, Skoplje. Glavni Urednik: Prof. Dr. R. Neubauer, Sezana. Medicinska Knjiga: Beograd Casopis Jugoslovenskih Ftiziologa. 1952. Pp. 557.

REPORTS

REPORT OF THE MEDICAL OFFICER OF HEALTH, CITY OF GLASGOW, 1951

In his annual report for 1951 Dr. Stuart Laidlaw makes the following observations concerning tuberculosis:

It is often asked if tuberculosis is better off under the National Health Service Acts. There is no doubt that it has received on the national basis a larger allocation of money than under local government. It is probable, however, that much of the resulting advantage has been neutralised by divided administration.

It seems futile to persist in claiming that tuberculosis administration is improved by being split into two camps. No one has ever before maintained that schism causes anything but weakness. The disease itself operates as an entity; why should the forces opposing it be divided? Yet this was the stated purpose of the National Health Service Acts.

These Acts placed Medical Officers of Health in a very weak position in respect of tuberculosis. The new legislation delegated to them the duties of prevention and after-care, but took from them the effective medical staff required to carry out these duties by transferring the Tuberculosis Officers along with their clinics to the Regional Hospital Boards. Some Medical Officers of Health, attempting to retain a unified service, agreed to re-delegate most of their duties to their former Tuberculosis Officers, now designated Tuberculosis or Chest Physicians. This precedent was highly disadvantageous to the preventive service. For example, a purely preventive function such as B.C.G. vaccination is carried out in some areas by the Tuberculosis Physicians and in others by the Medical Officer of Health's staff. The point has surely been reached when the initial error should be recognised and tuberculosis administration unified once again.

The lack of concerted effort is very apparent, and any lower mortality or notification figures are largely due to improvements in the clinical and therapeutic fields. B.C.G. is beginning to play a part, but the fundamental necessity for leadership still remains. Tuberculosis differs from most of the infectious diseases in being nearly always a family problem. It is a personal tragedy but a social disaster. The Medical Officer of Health is by the nature of his duties closely associated with these problems. There is much to be said for unifying the Tuberculosis Scheme under him.

AMERICAN TRUDEAU SOCIETY

Medical Section of National Tuberculosis Association

The Current Status of Isoniazid in the Treatment of Tuberculosis—A Report of the Committee on Therapy

A previous report of this committee mentioned the use of isoniazid in the treatment of tuberculosis and called attention to the fact that isoniazid-resistant tubercle bacilli appeared rapidly when this drug was used alone. Subsequent studies have confirmed this observation. Other studies suggest that the emergence of isoniazid-resistant strains of tubercle bacilli may be prevented or delayed by the concurrent administration of streptomycin or *p*-aminosalicylic

acid (PAS) or both. For these reasons, patients should not be treated with isoniazid alone. Further studies are needed to determine which combination of drugs will be most effective. In the meantime, if isoniazid is used, streptomycin or PAS or both should be given concurrently.

This committee is collecting reports of toxic reactions to isoniazid. Preliminary data emphasise the frequency of central nervous system effects, some of which are serious. The reactions vary from simple hyperreflexia to acute psychoses of the manic type. These reactions occur more frequently in patients with previous cerebral disease and idiopathic epilepsy. There is some experimental evidence that they might be prevented by the concurrent administration of phenobarbital. Allergic reactions have also been reported and may be manifested as dermatitis, chills and fever, purpura, arthralgia, or asthma. Albuminuria and microhæmaturia have been common but not serious. Hepatic damage has been detected in only a few instances. No serious blood dyscrasia has yet been reported.

Iproniazid appears to be even more toxic than isoniazid and is still available for experimental use only.

In view of the toxicity of isoniazid and the uncertainty about the control of isoniazid-resistant strains of tubercle bacilli, this committee still recommends the use of streptomycin two or three days a week and PAS several times a day as the chemotherapy of choice in the treatment of most patients with tuberculosis.

Reprinted from the "American Review of Tuberculosis," February 1953.

JOINT TUBERCULOSIS COUNCIL

Honorary Secretary's Report for 1952

The Officers of the Council have been: Chairman, Dr. Peter W. Edwards; Vice-Chairmen, Professor F. R. G. Heaf, Dr. J. E. Geddes; Honorary Treasurer, Dr. Norman J. England; Honorary Secretary, Dr. R. L. Midgley.

Three meetings have been held this year, on February 16, May 17 and November 22.

The Ministry of Health agreed to undertake the publication of the report of the Joint Committee on the Standardisation of Radiological Terminology and Radiographic Technique.

The Council set up a committee to consider the Memorandum of the National Birthday Trust Fund on the care of tuberculous pregnant women. As the British Tuberculosis Association had also been asked for its views on this Memorandum, a joint committee of the Council and Association was formed, and its report was sent to the National Birthday Trust Fund and the Ministry of Health.

The Radiological Committee was asked to consider and report on the best use for miniature films, and after discussion it was thought that this investigation could be more properly carried out by the Research Committee of the British Tuberculosis Association, which has agreed to do so.

The Children's Committee made certain recommendations which would bring the Council's report on the protection of organised groups of children from the risk of infection by adults suffering from tuberculosis, May 1948, more up to date, and secure better implementation of its recommendations.

The Council's representatives on the British Student Tuberculosis Foundation have continued to take an active interest in the establishment and development of this body.

The Council has continued its close association with the National Association for the Prevention of Tuberculosis on the Tuberculosis Educational Institute, whose chairman is Dr. R. R. Trail.

Other bodies on which the Council is represented are the British Council for Rehabilitation; Scientific Film Association; Tuberculosis Rehabilitation Council; National Birthday Trust Fund (Tuberculosis and Pregnancy Sub-Committee).

There has been a feeling in the Council that the time is ripe for full consideration into the changing character of tuberculosis, and a Committee has been set up to consider the best way in which this might be done.

NOTES AND NOTICES

TUBERCULOSIS EDUCATIONAL INSTITUTE, J.T.C. N.A.P.T.

Two Refresher Courses are to be held at St. Thomas's Hospital, from April, 14 to 17, 1953.

The course for doctors is on "Radiology in the Treatment of Tuberculosis," and amongst those participating are Dr. C. M. Fletcher, Dr. F. H. Kemp, Dr. J. J. McCann, Dr. George Simon, Dr. H. J. Trenchard, Dr. J. Duncan White and Dr. Paul Wood.

The course for Nurses, Health Visitors, Social Workers and Administrators is on "Domiciliary Treatment of Tuberculosis," and Dr. Marcia Hall, Dr. McCann, Dr. Simmonds and Dr. Stradling are participating.

THE THORACIC SOCIETY

The Spring Meeting of the Thoracic Society was held on Friday and Saturday, February 27 and 28, at the Royal College of Surgeons. There were two interesting discussions: (*a*) on "The Present Position of Artificial Pneumothorax in the Treatment of Pulmonary Tuberculosis," the opening speakers being Dr. A. F. Foster Carter and Dr. A. M. C. Macpherson; (*b*) on "Aneurysms of the Great Vessels" (excluding arterio-venous fistula). The opening speakers were Dr. N. Lloyd Rusby, Dr. P. Kerley, Mr. S. G. Griffin.

Short communications were also given on: (1) "Two Cases of Congenital Vascular Ring: one associated with Congenital Œsophageal Atresia," Mr. J. S. Davidson. (2) "Pulmonary Tuberous Sclerosis," Dr. J. Dawson (introduced by Dr. J. C. Hoyle). (3) "Acid-base Changes in Thoracic Surgery," Dr. E. H. Milne (introduced by Dr. B. G. B. Lucas). (4) "The Ventilatory Function of the Lungs in Sarcoidosis," Dr. F. J. Prime. (5) "The Use of Intrapleural Injections of Kaolin Suspension in producing Pleural Adhesions," Dr. J. Maxwell. (6) "Pulmonary Hypertension in Anoxic Chronic Cor Pulmonale," Dr. W. Whitaker.

THE BRITISH TUBERCULOSIS ASSOCIATION

The Tuberculosis Society of Scotland—Annual Conference, 1953

This Conference is being held from July 1 to July 4 and the subjects on the programme are: Field Surveys, Chemotherapy, Tuberculosis in Infancy—certain aspects of Immunity and Pathology, Tuberculous Endometritis, Renal Tuberculosis, Pulmonary Disease of Industrial Origin, Diagnostic Bronchoscopy in Chest Clinics, Pulmonary Function in Pleural Effusions, Demonstrations at Centres in the City.

IN MEMORIAM

MARC DANIELS, M.D., M.R.C.P., D.P.H.

DR. MARC DANIELS died on March 3. At the age of 46 he had already gained an international reputation by his work in tuberculosis. It is easier to assess the value of this work than to define the qualities of the man himself, for he was above all else modest and self-effacing.

Although Daniels's main interest lay in the epidemiology of tuberculosis, it is probable that the work he did on antibacterial treatment was his most important contribution to medicine. The success of the Medical Research Council's trials of streptomycin and other drugs in pulmonary tuberculosis was largely due to his efforts. The trials did more than provide information of great clinical value: they led to the evolution of rapid and precise methods of evaluating new drugs and demonstrated that the treatment of such a variable disease as pulmonary tuberculosis could indeed be investigated by scientific methods. The effect of these methods on the progress of medical science in general may ultimately be more far-reaching than the results, important as they are, of the trials themselves. To Daniels belongs much of the credit for this.

By the time he turned to medicine he had already served an apprenticeship in science, having studied in Paris and Manchester, where he took a B.Sc. in 1927. He returned to Paris in 1929 and qualified there seven years later. He then took the Scottish Conjoint degree and the D.P.H. Soon after qualifying he began tuberculosis work. But it was not until 1942, when he left the public health and tuberculosis services in Lincolnshire and became Scholar to the Prophit Survey of the Royal College of Physicians, that he found full scope for his research ability. He played a large part in the preparation of their report on *Tuberculosis in Young Adults*, marshalling the mass of data accumulated by the Survey into precise and lucidly expressed conclusions. As a result of this he was later able to help considerably in the deliberations that finally resulted in the inclusion of tuberculosis in nurses as an industrial disease. His knowledge of the epidemiology and control of tuberculosis was increased by service as a consultant to UNNRA after the war. In 1946 he joined the Tuberculosis Research Unit of the Medical Research Council. He was frequently called upon to advise on problems concerning control of the disease in many countries of Europe; in 1947 he helped to prepare a report on tuberculosis in the British Zone of Germany and in 1951 investigated the prevalence of the disease in displaced persons' camps in Trieste.

His ability to reduce complicated data to simple facts was again demonstrated by his analysis of the Medical Research Council's tuberculin survey in 1952. The fact that, in spite of all difficulties, adequately controlled trials of BCG are in progress in this country, although on a smaller scale than had been hoped, owes much to Daniels's tenacity, patience and tact. His wide interests outside medicine gave him a breadth of outlook that, together with his patent intellectual honesty, admirably fitted him for the task of co-ordinating large-scale co-operative research. He had a passion for accuracy and an infectious enthusiasm that stimulated others less absorbed in the particular project to produce the detailed data that were required.

In the autumn of 1952 he became ill and knew that he could not recover. He continued to work. But he insisted that the gravity of his illness should be kept from his friends as long as possible. It was entirely typical of him.

J. R. B.